DELAMOTTE'S

PRACTICE OF PHOTOGRAPHY

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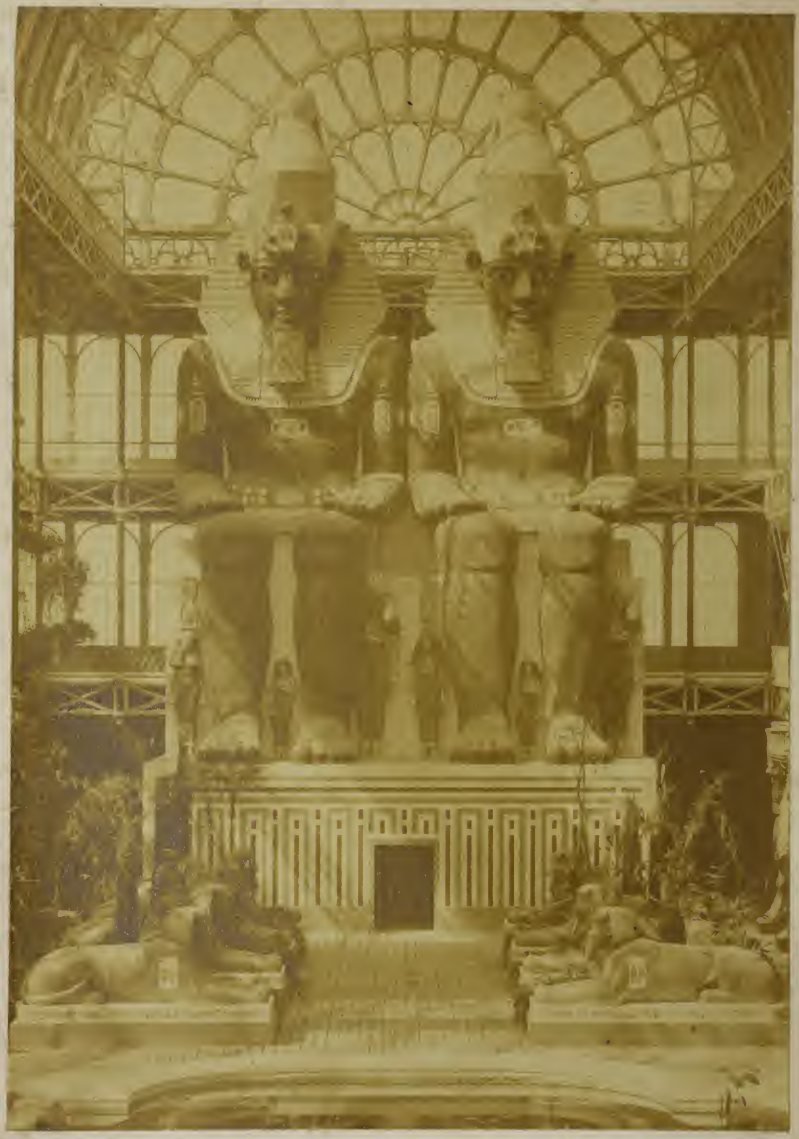

THE

PRACTICE OF PHOTOGRAPHY

A MANUAL

For Students and Amateurs.

BY

PHILIP H. DELAMOTTE, F.S.A.

SECOND EDITION, REVISED.

ILLUSTRATED WITH

A PHOTOGRAPHIC PICTURE PRINTED FROM A COLLODION NEGATIVE.

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PREFACE TO THE FIRST EDITION.

HAVING been frequently solicited by my friends and pupils to supply them with brief instructions in the various Photographic Processes, I have prepared this little manual on a simpler plan than any other treatise I have met with, by endeavouring to carry the student directly, through the various stages of each process, without distracting his attention by untimely digressions on the manufacture of chemicals or of apparatus—knowledge very useful in its place, but a stumbling-block when ill-timed. I have first described the Processes on Paper, both for Negatives and Positives; then proceeding to Glass, I have given in detail every information connected with Collodion and Albumen, and I think everything essential to the attainment of a good photograph will be found mentioned. Amid the immense variety of formulæ

and methods recommended by different experimenters, I have selected those which experience has assured me are the best under all circumstances; but in an art of such wonderfully rapid progress we must expect great improvements daily: these shall find place in future editions, should they be called for.

One feature in this work, which I hope will be found useful, is the description of the various chemical substances used in Photography: instead of being introduced in the space devoted to the details of manipulation, they are grouped together at the end: for these, and for the general revision of the work, I am indebted to the kindness of Mr. Thomas Delf, who undertook a task which the numerous demands upon my time forbade me fulfilling so carefully as the subject required.

P. H. D.

PREFACE TO THE SECOND EDITION.

A NEW edition of this little manual being called for, I have availed myself of the opportunity to make such additions and alterations as experience has shown me to be valuable, and to correct a few errors which, in the unavoidable haste attendant upon the production of the former edition, were overlooked.

I have the gratification of knowing that this treatise has been found useful by a large body of amateurs; and I hope the present revised edition may contribute to render the fascinating art of Photography still further accessible to those who undertake it.

The art of Photography continues to advance towards perfection, mainly owing to the great improvement in the preparation of Collodion: numerous suggestions are also constantly made to extend its applications, many of which

have already proved valuable as aids to art and science; the chemical principles upon which Photography is based are also more clearly understood:—and I must not omit to add that I have received much valuable assistance from Mr. J. B. Hockin, in the chemical portion of this book.

P. H. D.

Crystal Palace, Sydenham,
September 1854.

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INTRODUCTION.

Definition. Photography or Heliography.

(1.) PHOTOGRAPHY—a word derived from the Greek—signifies "to draw by the agency of light;" but as recent researches have proved that light, in the ordinary acceptation of the term, is not the active agent through which the desired effects are produced, the word HELIOGRAPHY, or "sun-drawing," has been suggested as the more correct; yet, notwithstanding the inaccuracy involved, it will be more convenient, for the purpose of description, to retain the term "Photography," and to assume that light is the agent by which its results are obtained.

Fixes the Images of the camera obscura.

(2.) The art of Photography enables us to obtain upon paper, and other media, permanent impressions of the images of objects which are received in the focus of the camera obscura.

Results already obtained.

(3.) This wonderful result, which but a few years since was regarded as a hopeless dream, has been realised through the labours of Daguerre,

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Niepce, Herschel, Hunt, and others engaged in scientific investigations, and already attained to a degree of perfection far outstripping the most sanguine expectations. But rapid and wonderful as have been its achievements, we think ourselves justified in regarding the art as still in its infancy, for its processes and manipulation require a nicety and delicacy unknown in any other art whatever; while, at the same time, the nature of the action of the chemical and other agencies employed is but now beginning to be understood. We may, however, congratulate ourselves that the art of photography has attained a very satisfactory degree of simplicity and certainty, and that frequent discoveries are made which greatly facilitate its operations.

The scientific principles involved must be studied.

(4.) Although it is desirable, for many reasons, to describe the practice of the art of photography without entering upon the discussion of the scientific principles involved, or the employment of technicalities, yet it must not be expected that while so many refined considerations are concerned in its operations, success can always attend the efforts of the photographer unless he pays to these principles the obedience they demand: he must, sooner or later, become acquainted with them. It is true that any one entirely ignorant of the theory or practice of chemistry may by a happy hit succeed

at once in producing a good picture; but as he knows neither the causes of his success, nor upon what it depends, he may meet with an overwhelming amount of discouraging failures without having the power to remedy them, or to trace their origin. It is true, also, that patience and long-continued perseverance may supply the want of this knowledge, and may overcome many difficulties, but much loss of time and waste of materials are involved. Nevertheless it must be admitted that recent improvements have so simplified the processes of the art, as to render chemical knowledge of much less consequence than heretofore. Therefore it will be our object in the following pages to present the details of each operation in such a shape as will be clear to the mind of any one entering upon the pursuit; while, at the same time, the *rationale* of each operation will be given in such form and language as will enable the beginner to test his position at every stage, and to trace and remove any impediments he may meet with. It is not proposed to give a history of the art, having now nothing to do with past failures, but only with the successful results of a multitude of experiments all tending to one aim,—the greatest excellence and expedition in obtaining good photographs.

On the Production of a Photographic Picture.

Upon what the production of a photograph depends.

(5.) The production of a photographic picture depends upon the chemical action on various substances, of a certain power (*Actinism*) which exists in the rays of light in connexion with two other powers, viz. the *luminous* and the *heating*, neither of which produces the same chemical change upon the materials submitted to their influence in the art of photography, as the *actinic*, or chemical power does. It is not the object of this treatise to dwell upon the abstruser portion of the subject; we must confine ourselves to detailing the best manipulatory processes, with such explanation of the scientific principles involved, as may enable the amateur to practise the art with intelligence and certainty.

The principal photographic agents are iodide and nitrate of silver.

(6.) The principal agents employed, after numerous experiments upon other substances, still continue to be iodide and nitrate of silver, substances highly susceptible of the influence of light, which so acts upon, and alters the normal condition of their particles, as to set up a new action; and, by further accelerating this action, we obtain the desired photographic pictures.

Preliminary processes.

The preliminary processes for *Negatives* consist in:—

I. IN THE PAPER PROCESS,

On paper.

Spreading upon paper a coating of iodide of potassium.

OR, IN THE GLASS PROCESS,

On glass.

Coating a plate of glass with iodized collodion, albumen, &c.

Exciting the paper, &c.

II. *Exciting*, or bringing the surface of the prepared paper or collodion into contact with a solution of nitrate of silver, by which decomposition ensues, and iodide of silver is produced in chemical combination with an excess of nitrate of silver. The paper, or other medium, is now ready for the camera.

III. *Exposing the Paper, or other medium, in the Camera.*

Exposing the same in the camera.

Upon being placed in the focus of the camera, the varied light of the image in the focus acts unequally upon the prepared sensitive surface; and according to the degree of illumination of the various parts of the image, so the surface becomes, in the subsequent processes, more or less darkened: those parts which are most illuminated in the object producing the greatest amount of blackening effect upon the sensitive surface.

IV. *Developing the Image.*

Development of the image.

The paper, or other medium, after having been submitted to the action of light in the camera, but rarely exhibits any of the change which has taken place upon its surface: the picture is invisible, until the developing agent is applied, which may be either gallic acid, pyro-gallic acid, formic acid, or a proto-sulphate of iron, &c. This developing is a continuation of the action excited by light. When the light strikes upon the sensitive medium, it imparts to the sensitive salts a tendency to be *reduced*, and this tendency to change is perfected by the developing agents above-mentioned acting in virtue of their affinity for oxygen.

V. *Fixing the Image.*

Fixing the image.

This process consists in carefully removing from the surface of the medium all the iodide of silver, &c., which has remained unacted upon by the light; this is accomplished by treating it with a solution of hyposulphite of soda, or of cyanide of potassium, which dissolves the undecomposed salts of silver, and renders the picture no longer susceptible of the action of light.

Such, briefly, are the successive operations for obtaining a Negative picture, which serves as a source from which a large number of Positive copies on paper may be obtained; or the development may be so modified in the collodion process as to produce at once positive pictures on the glass.

(7.) Positives are produced upon paper prepared with nitrate of silver, the surface albumenized (80) or not.

The operations of the Photographer require cleanliness and accuracy

(8.) The successful practice of the art of photography requires on the part of the operator the most scrupulous cleanliness and accuracy in the employment of every material used in the processes, and the most implicit obedience to the rules laid down in these pages for his guidance, for they are the result of much patient investigation on the part of a host of intelligent inquirers, who have successfully overcome difficulties which, could they have been foreseen, would have discouraged the most patient and determined mind. Happily for the photographer who now commences his career, he can profit by this experience, and be spared the labour and expense of original investigation. The path for him is tolerably smooth, and should he be induced to examine carefully the abstruse philosophical principles upon which this fascinating art depends, he may in his turn become a contributor to its improvement and advancement. The humblest experience, guided by a careful observance of phenomena, may furnish suggestions which the most refined and cultivated investigator has failed to arrive at.

APPARATUS AND MATERIALS.

Apparatus and Chemicals.

(9.) The apparatus and chemical materials employed must be selected with care and judgment. The former need not be of the most expensive kind; all we demand of it is, that it should be capable of fulfilling the conditions imposed upon it by the requirements of the art. The chemicals must be such as are prepared especially for the purpose; and to secure himself from disappointment and failure, the operator should purchase them only of respectable dealers in photographic materials.

Vary much in quality.

(10.) Acetic acid, ether, and other preparations, vary in quality, and an inferior article cannot be substituted for one of the proper strength and purity.

Choice of, for the various processes.

(11.) Much of the time of early practitioners was wasted in the preparation of various materials, but now everything required may be bought, and in a few hours a perfect equipment obtained. The selection of them must of course depend upon which method of operating is adopted,—whether on plain paper, waxed paper, or albumenized paper, or on glass covered with albumen or collodion. For operations out-of-doors, the waxed-paper process possesses some advantages over most other modes of working, as little or nothing is required to be carried besides the camera and the prepared papers.

THE CAMERA.

(12.) The choice of a camera will depend upon the purpose to which it is applied, whether for portraits or landscapes; the sizes varying from those of about five or six inches square to others which will give a picture of twelve inches square and upwards. The prices of cameras vary considerably, according to the quality of the lenses; as one with a single lens (meniscus) may be obtained for a few shillings, while others, with two achromatic lenses, manufactured by Voigtlander, Chevallier, Lerebours, Ross, and others, cost as many pounds. As good pictures may probably be obtained with one kind as with another, the advantage of the twofold achromatic arrangement is, that for taking portraits it concentrates the light in the image, and thereby accelerates the process, while it also gives that image tolerably free from spherical and chromatic aberration.

Camera.

Its lenses.

(13.) For landscapes and views generally, a single achromatic lens, about three inches in diameter, of long focus, say from twelve to eighteen inches, is the most suitable.

For landscapes.

(14.) For portraits, a double achromatic lens is necessary, for the reasons stated above.

For portraits.

(15.) In a simple lens, that is, one composed of a single piece of glass, there are two foci: the one,

Foci in a simple lens.

Introduction.

where the image appears clearest and well defined—this is termed its *visual* focus; the other, which is a little nearer to the lens, is the *chemical* focus, or where the greatest amount of chemical action takes place.

Achromatic lens.

(16.) An *achromatic* lens is always composed of two pieces of glass of different dispersive powers; that is, the one has its chemical focus at a certain distance from the visual focus; the other, also at a certain distance, but a little nearer to, or farther from, the apparent focus, according to the composition of the glass.

Construction of.

One piece of the achromatic lens consists of a double convex lens of crown glass; this disperses the rays too much, to correct which defect we add a *concave* lens of flint glass, which of itself would cause the dispersion of the rays to be too little; but these two lenses being put together, they correct each other, and unite the rays at very nearly the same point, making the chemical and apparent foci identical. By giving the proper form to the surface of these lenses a compound lens may be produced, which shall correct not only this *chromatic* aberration, but also the *spherical* aberration, or that which produces distortion in the image of an object. A lens which corrects both chromatic and spherical aberration is said to be *aplanatic*.

Corrects both spherical and chromatic aberrations.

Aplanatic lens.

Diaphragm.

(17.) It is usual to place in front of the lens a disc of brass, perforated in the centre with a hole of

given diameter, capable of being removed to give place to others with holes of different diameters; these discs are termed *diaphragms*, and their purposes are,—to exclude the excess of light falling upon the lens, which would weaken the impression of the image,—to diminish the spherical and chromatic aberrations,—and to give a greater amount of distinctness to the image: but at the same time they exclude much light, and thereby lengthen the time of the operation; yet with lenses of large diameter they are indispensable: the greater the amount of light falling upon the object to be copied, the smaller may be the aperture in the diaphragm. A diaphragm placed *between* the lenses, *nearly* corrects both the spherical and chromatic aberrations in ordinary lenses.

Cap.

(18.) Another disc, called a *cap*, is used, in taking a picture, for shutting out entirely the light from the camera, and stopping its action instantly.

Lens for Portraits.

(19.) It must always be borne in mind, that the nearer the lens is placed to the object to be copied, the larger the image produced in the focus, and the greater the distortion (23). In portraits, where great concentration of light, and consequent rapidity of action, is desirable, a combination of lenses producing a focus of five or six inches is the best; if the image of the face is formed as near as possible in the centre of the lenses, the amount of distortion is so small as to be quite

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undiscernible; if any occurs in the accessories, it is of less importance (57).

Interior of camera

(20.) The interior of the camera must be carefully blackened; whatever the material used, it must be deadened so as to *reflect* no light, but absorb all the rays not falling upon the prepared surface placed in the focus.

Adjustment of frames to focus.

(21.) Great care must be taken to test the accuracy of the adjustment of the frames fitting into the place of the ground glass, so that the prepared surface falls exactly in the same vertical plane as that occupied by it when the focus is ascertained; any deviation from which would cause indistinctness in the impression (56).

Tripod-stand for camera.

(22.) The Tripod-stand.—In taking views the camera should be elevated upon a tripod-stand, to a height about equal to that of the eye of the operator.

Portraits.

To avoid distortion in.

(23.) In portraits, the lenses being of short focus, very small projections from the object produce great distortion in the image; it is, therefore, desirable to keep the various parts of the object, as much as possible, in the same plane: for this reason, if the body is turned direct to the front of the lens, the head should be on one side, so as to give the face in three-quarter view, or nearly in profile.

Portraits are best taken in an open space out-of-doors. As this, however, is not always convenient or practicable, we require to fit up a place for the purpose: the conditions necessary to be fulfilled are, free access of light, and avoidance of shadows from contiguous objects. In cities, a room constructed of glass, built on the roof of a house, will be the most suitable; but in isolated dwellings, a room well lighted in the ordinary manner will answer every purpose. The sitter should be conveniently seated opposite the window, and the camera so placed as not to obstruct the direct light falling upon the sitter: a large screen of white cloth or paper should be so adjusted as to throw a reflected light on one side of the person, while the other receives the stronger direct light. The background must be varied in tones of grey from nearly white to black, so as to form a suitable contrast to the drapery of the sitter, which, if of blue or light greys or white, may require the background to be black or nearly so. If, on the contrary, the drapery is black, or red, and such other colours as *come out dark* in the photograph, then the background should be lighter, but never white. As a general rule, the lightest part of a positive photograph should be the face, upon which all the interest of the picture is concentrated; the exceptions to this rule consist of the grey hair of aged persons, and some parts of the drapery.

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If the hangings of the operating-room are of a dark colour, they will absorb much of the light that would otherwise be reflected upon the sitter: the predominating colour should be light blue, or blue grey.

The *pose* of the sitter is very important, the best aspect is that which presents three-fourths of the face to the lens; taken full-face, parts are always more or less out of focus, and consequently distorted. All the parts of the figure should be kept as much as possible in the same plane.

Head-rest.

(24.) Head-rests. — In taking portraits it is advisable to place the head of the sitter against a head-rest: this little instrument greatly assists the keeping it in one position. Care must be taken that no part of it is visible in the picture.

THE OPERATING-ROOM.

Operating-room.

(25.) Photography requires that most of its chemical operations should be conducted in a room from which the daylight is either totally excluded, or admitted through a transparent yellow medium, such as stained glass, dyed linen, calico, coloured paper, sheet india-rubber, or similar material; or, which is not so good, the room may be illuminated by a screened candle or gas-light; for it must always be kept in mind that it is through the agency of *white light*, and its peculiar action upon the chemicals we use, that pictures are obtained; and whenever a sensitive preparation is exposed, if but for an instant, to its influence out of the camera, a change is in operation which neutralises all our subsequent exertions. Therefore, during every stage of progress in the preparation of the sensitive surface until it is finally *fixed* and thereby rendered no longer susceptible of alteration by the action of light, we must carefully guard against any kind of exposure to its influence. A disregard of this condition is undoubtedly the cause of many failures which are attributed to other causes. The operations of light are very subtle and mysterious: recent researches show us that it is constantly changing the equilibrium of all bodies exposed to its influence; its rays possess a compound influence and agency;

Action of light.

INTRODUCTION.

part of them give *heat*, part *light*, and others a chemical action, or, as it is now called, *actinism* (5). It must suffice for our purpose to merely mention these, and remark that it is not by the agency of the *light* rays alone that photographic pictures are produced; at present it is thought that the *chemical* or *actinic* rays are those which set up the change in the materials with which we operate; still it is most convenient for the purposes of description that we should continue to apply the term *light* to the agent by which our desired results are effected.

Actinism.

(26.) It is a great advantage to the photographer if his operating-room contains a cupboard in which the materials can be put away out of the dust and obnoxious vapours always present in the atmosphere, and where he can suspend his sensitive papers while they are drying. A sink, or similar convenience, for the washings and other operations, and an abundant supply of filtered water, are indispensable.

Cupboard and Sink.

The different operations of developing and fixing should, whenever practicable, be performed at different places in the room, exclusively appropriated to them, so as to prevent accidents occurring from accidental splashes from the cyanide of potassium, &c. To effect this object, two sinks on opposite sides of the room, or otherwise separated from each other, will be found highly advantageous in insuring cleanliness and neatness in manipulation.

LANDSCAPES, &c.

(27.) The out-of-door operations of photography, especially when a journey must be undertaken, involve much care and forethought, when the operator uses collodion. Everything required must be carefully selected and packed, and in quantities adapted to the extent of the operations contemplated. In addition to the apparatus, necessary for in-door operations, a *tent* or something equivalent to one is required, in order to carry on the developing process out of the influence of white light. Everything required for a long journey, however, can be conveniently and safely packed within the space of two cubic feet. Landscapes. Tent.

On arriving at the site of the proposed view, the operator, before using the camera, should examine the capabilities of the scene, so as to select the best point of view, and the hour should be chosen when the shadows of objects are cast at an angle of about 45° or less. If the sun shines care must be taken that it does not fall *into* the camera, or cast upon the lens any light reflected by polished objects. Selection of view.

The advantages of the waxed-paper process for travelling operations are so great, that it seems superfluous to enlarge upon them; when it is considered that the only apparatus necessary to be Advantages of waxed paper.

INTRODUCTION.

carried consists of the camera, and a portfolio with a sufficient supply of waxed-paper, it will be evident that the greatest perfection in this method is a desideratum to which all our efforts should be directed.

Black mirror

A black mirror, such as is used by artists, will be found useful in making choice of a view, as, by neutralising the colours of objects, it more nearly exhibits the resulting photographic effect.

PHOTOGRAPHY,

ON PAPER AND ON GLASS.

PHOTOGRAPHY.

On Paper.

(28.) The announcement of the discovery of the art of Photography was so unexpected and startling, and its capabilities so evident and so wonderful, that the whole scientific (as well as the artistic) world were interested in them, and directed its attention to their development and perfection; with what success we need scarcely inquire, for the results meet us on every side. Almost simultaneously with the publication of M. Daguerre's discovery of photography on silver plates in 1839, Mr. Fox Talbot communicated his own for obtaining the images of the camera obscura on paper, the *Calotype:* at first very imperfect, but afterwards greatly improved by the experiments and suggestions of Herschel, Hunt, Wood, and others. Most of these improvements were embodied in a patent obtained by Mr. Talbot in 1841, but it may

Discovery of Photography

Improvements by Herschel and others.

PHOTO-GRAPHY.

easily be proved that a good photograph *cannot* be obtained by adhering to the processes detailed in the specification of Mr. Talbot's patent; nor would photography have ever attained to the high degree of excellence it now exhibits if the impediments thrown in the way of this art by so mischievous a monopoly had not served as a stimulus to ingenuity in the discovery of *other* substances and *other* methods by which good results could be obtained. These processes are known as the amphitype, the cyanotype, the chromatype, and the catalysotype; but as all of them are *processes on paper*, the right to use which was claimed exclusively by Mr. Talbot, a substitute for that medium was sought and found in Collodion, for which we are indebted to Mr. Archer, to whom the gratitude of every photographer is due for emancipating them from the legal trammels by which this art was fettered. Albumen on glass for negatives also offers a good substitute for paper, and is extensively employed for that purpose by Continental photographers.

It is, however, due to the memory of our distinguished countryman, Wedgwood, to state, that so long back as 1802, he was occupied, in conjunction with Sir Humphry Davy, in attempting to fix the images of the camera obscura. His want of success was probably due to the imperfect state of chemical science at that period.

(29.) The various improvements alluded to enable us now to obtain good views, portraits, &c., on paper, in a space of time varying from a few seconds to half-an-hour; while on collodion, instantaneous exposure of the sensitive surface to the image in the focus of the lens is sufficient to impress a good picture.

Time required on paper and collodion.

PROCESSES ON PAPER.

PROCESSES FOR NEGATIVES ON PAPER.

(30.) THE processes on paper may be divided into two varieties,—the *dry* and the *wet;* the former is the most convenient, and that generally practised; by some practitioners the latter is preferred: we shall here describe both processes, beginning with— Wet and dry processes.

THE DRY METHOD.

(31.) This process is deserving of the most assiduous cultivation; for its simplicity and ready manipulation give to it many advantages over other methods; in employing it, we simply carry a stock of prepared papers to any distance, and after exposing them in the camera to the desired object, reserve the further stages of the process until we return to the conveniences of the operating-room. Whatever imperfections at present exist in this method will doubtless soon be overcome: the results obtained at the hands of several eminent The dry process.

NEGATIVES.

photographers leave but little to desire; in fact, in many positive proofs it is difficult, if not impossible, to discover whether they have been obtained from negatives on glass or on paper.

Paper employed.

(32.) The paper used for negatives may be employed either waxed or unwaxed. As good results are obtainable from the one as from the other; the employment of the latter saves much trouble; and the proofs can be rendered transparent by waxing *after* they are developed.

The quality.

(33.) The quality of the paper used is of vital importance in this process; it must be as thin as possible, yet of perfectly homogeneous texture throughout.

Proportions of iodine and silver.

(34.) The proportions of iodide of potassium and nitrate of silver in the solution employed differ much in the practice of various photographers; under all circumstances it is necessary that the nitrate of silver be in excess over the iodide employed, as even when the nitrate of silver and iodide of potassium are mixed in equivalent proportions, the resulting iodide of silver is scarcely acted upon by light.

We now proceed to detail the processes with waxed-paper by the dry method.

WAXED-PAPER PROCESS.

Apparatus.

Camera and Lens.
Tripod-Stand.
Glass, Porcelain, or Gutta-Percha Dishes.
Glass Measures, Funnels, Rods, &c.
A Spirit Lamp.
A Polished Metal Plate.
Thermometer.

Materials.

Paper for Positives.
Paper for Negatives.
Bibulous Paper.
A Portfolio containing Bibulous Paper.
Pure White Wax.
Clean Rice.
Isinglass.
Distilled Water.
Iodide of Potassium.
Fluoride of Potassium.
Cyanide of Potassium.
Iodine.
Nitrate of Silver.
Glacial Acetic Acid.
Gallic Acid.
Hydrochlorate of Ammonia.
Hyposulphite of Soda.
Sugar of Milk.
Camphor.

1. Selection of Paper.

Negatives.

(35.) The early photographers encountered great and discouraging difficulties in procuring paper suitable for the purpose of their art, which now no longer exist to the same extent. Good papers may be obtained of various degrees of thickness, uniform texture, well sized and glazed, both of English and French manufacture; some prefer the former, others the latter. The difference in their quality appears to consist in this,—the English papers are hard and dense, owing to their being sized with gelatine, or resin soap, consequently the sensitive preparation does not so readily penetrate its substance, but remains more on the surface, they are, therefore, best fitted for positive proofs. The French papers, on the contrary, are generally sized with starch, with which iodine enters eagerly into combination: they are usually thinner and lighter, and consequently better adapted for negatives; but both English and French papers are prepared for positives and negatives; and the photographer can select either without any reserve; only with this precaution, let him avoid using different papers as much as possible, for the difference in their manufacture causes them to be affected unequally under the same treatment. If bought of an honour-

French and English paper.

For Positives

For Negatives.

Only one quality of paper to be used.

able dealer in apparatus, &c. there is little fear of an unsuitable material being offered for sale. All the success of manipulation may rest upon the quality of the paper.

Examine each sheet carefully for defects.

(36.) Previous to using the paper, each sheet must be examined for spots and holes; if any such exist that sheet must be rejected. The demand for a fine material for the purposes of photography has become so extensive, that several manufacturers have devoted their attention to the preparation of a pure paper, but the result is not yet all a photographer can desire. Among English manufacturers, Whatman, Nash, Towgood, and Turner, are eminent; Canson frères, Marion, and Lacroix, are the most eminent of those of France. Lacroix's paper appears to give the greatest rapidity, doubtless owing to its containing the largest quantity of starch. For waxing, thin paper will answer better than thick, if of homogeneous texture; and the starch size in the French paper is of great importance.

Waxing the Paper.

Waxing the paper.

(37.) Suitable waxed paper for photography has now become an article of commerce, and as the preparation of it is troublesome, we do not recommend the photographer to undertake it. If, however, he prefers to do so, the following is the mode of preparing it:—Take a tin dish fitting into another, having a water-space between, fill the

lower one with water, and place it on a stand so that a gas-burner can be passed under and maintain it at a steady temperature; when the dish is sufficiently warm, rub it all over with a piece of clean white wax; then lay upon it carefully a sheet of the thin negative paper, so that no air-bubbles are formed, and as soon as it is penetrated by the wax, cover it with another sheet; have ready a heated plate, upon which put a sheet of unwaxed paper, and place upon it the two waxed sheets, cover them with a sheet or two of unwaxed paper, and allow the excess of wax to be absorbed by them, by which means any waste of wax may be avoided; repeat this operation so long as any excess of wax is absorbed by the clean paper, and finally place it between several more fresh sheets, upon the clean hot plate, and pass over them a hot smoothing-iron until the whole excess of wax is removed. This operation is best performed by two persons, one to each plate; as the wax cools so rapidly when removed from the dish, much time is wasted in the manipulation when performed by a single person. The paper used for absorbing the excess of wax is placed in the dish, in order to become thoroughly saturated, and then removed and treated as before directed. The preparation of a hundred sheets in this manner is a good day's work.

Waxing the paper.

NEGATIVES.

Quality of paper improved by waxing.

(38.) This waxed paper possesses some excellent qualities, which render it exceedingly valuable to the photographer. It is transparent, which enables him to perceive the smallest bubble of air that exists between it and the exciting solution upon which it is floated: it has become exceedingly tenacious, somewhat resembling vellum; and it will admit of a proof being left in the developing solution for a considerable time, without spotting or staining the solution; but, above all, it permits us to prepare sensitive paper with the nitrate of silver, and keep it ready for use during many days, weeks, or even months. This quality is of immense value for operations out-of-doors, since it is no longer necessary to carry a cumbrous and fragile array of bottles and dishes; a portfolio and a camera suffice for a long journey. The waxing also enables us to obtain much deeper blacks upon thin paper than we could were it not employed.

PREPARATION OF THE SENSITIVE PAPER (IODIZING).

(39.) To increase the sensitiveness of paper in the subsequent processes, it is found useful to introduce among the chemicals certain substances termed *accelerators*. For this purpose, the French chemists have suggested sugar of milk and starch (162); this latter has the additional recommendation of entering into combination with iodine.

Use of starch in the preparation of sensitive paper.

Accelerators.

(40.) Starch exists in many vegetable grains, roots, &c.: the best for the purposes of photography is obtained from rice.

Rice-starch.

To prepare it, take

Distilled water . . .	3 pints
Washed rice	4 ounces
Isinglass*	½ ounce.

Boil them in a glass or porcelain vessel, and filter through a clean cloth. The boiling must be continued only until the grains of rice begin to break, and stopped before the water is thickened by excess of starch. Take that portion of the liquid which has become perfectly clear by repose, to which the following ingredients are added, it gives a good

* Genuine isinglass is required—not the spurious substitute, *gelatine*.

NEGATIVES.

body to the paper, and yields very excellent tones of black in the proofs. The following is Le Gray's formula.*

Dissolve in 35 fluid ounces of this rice-water,

Formula for the sensitive preparation.

Sugar of milk . . .	693 grains
Iodide of potassium . .	230 „
Cyanide of potassium . .	12 „
Fluoride of potassium . .	7 „

(41.) When these are dissolved, strain through a fine cloth, and preserve the liquid for use in a well-closed bottle: it will keep for a long time without deterioration. In cold weather, it should be made tepid before using.

Iodizing the paper.

(42.) To iodize the paper, put a quantity of the solution into a clean porcelain dish, and float therein a sheet of waxed paper, then with a brush cause the liquid to extend over its upper surface, and then sink it in the liquid. As many as twenty sheets of paper may be prepared at one time, provided the liquid completely covers them: they should be left in the liquid from three to six hours, according to the thickness of the paper.

(43.) When the waxed paper is placed in the bath of iodide of potassium, &c., these salts appear to completely penetrate the wax and possibly enter into combination with it, the greasiness of surface disappears, and the paper takes freely the solution

* For other formulæ see Appendix.

of nitrate of silver. This effect, however, does not take place immediately, but requires several hours before the wax becomes permeated.

(44.) At the expiration of that time, take up the mass of paper, and turn it so that the sheets which were lowest become uppermost; then hang them up separately by one corner to drain, and to the bottom of each sheet attach a piece of blotting-paper to facilitate the dropping of the fluid. It tends materially to prevent *streakiness* if each sheet, previous to being suspended, is drawn through some distilled or rain-water.

Only one kind of paper to be used in the same fluid.

(45.) Two different kinds of paper should not be placed at one time in the bath. Paper sized with this fluid has frequently a light violet tint, which is not objectionable, but, on the contrary, is useful in the subsequent operation, as it serves to show when the action of the nitrate of silver upon the iodide is completed. Mr. Crookes recommends the addition of iodine to the iodizing liquor, to insure this coloration and assist in the removal of specks of iron.

(46.) Paper thus prepared is said to be *iodized;* it is insensible to the action of light, but too much exposure is prejudicial.

The liquid will serve for fresh paper as long as it lasts, taking the precaution of filtering it after use, and adding iodine as required.

This preliminary preparation is also applicable to unwaxed paper for negatives.

EXCITING THE IODIZED PAPER.

Production of the iodide of silver.

(47.) Have ready two or three glass or porcelain dishes, of a size sufficiently large to contain the paper; fill one with distilled water, into the other put the following mixture,—

Distilled water . .	1 oz.
Nitrate of silver . . .	30 grains
Glacial acetic acid . .	35 minims

The acetic acid to be added after the nitrate of silver is dissolved.

(48.) The iodized paper is to be taken carefully by its opposite corners, one side being previously marked with a pencil, and laid dexterously upon the surface of the fluid in the dish, avoiding air-bubbles; let it remain about five minutes, or until the surface which was tinted with the iodine has become yellow by the action of the nitrate of silver; then remove the paper to the dish of distilled water, and immerse until the water contains all the sheets submitted to the action of the silver. If the paper is not required for immediate use, it should be washed in another portion of distilled water. The water used in these washings acquires a quantity of nitrate of silver, and should not be thrown away, but preserved for a subsequent operation—the Developing, which will be explained hereafter (65).

(49.) After the washing, each sheet of paper must be drained for a few moments, and subsequently dried between folds of blotting-paper, and preserved in a portfolio out of the light. The whole of this operation above described must be performed by yellow light.

(50.) Unless the paper is washed once or twice in distilled water, it is nearly certain to become stained, even when kept in a portfolio, out of the reach of daylight. This discoloration is caused by the decomposition of the large excess of nitrate of silver, which the washings remove to a certain extent and thereby retard chemical change, but at the same time they render it much less sensitive.

(51.) The operator must be careful not to touch any part of the paper with his fingers, except the corners by which it is held.

To prevent the paper becoming discoloured.

(52.) This paper should be preserved in a blotting-book kept tightly pressed, as the sensitive salt is decomposed, not only by access of air, but by the sulphuretted vapours evolved wherever even a few houses are congregated; it will retain its sensitiveness for three or four weeks, or even more, if carefully prepared; hence it becomes exceedingly valuable to the traveller, as it enables him to dispense with many delicate manipulations which are performed with difficulty out-of-doors; and the "developing" may be deferred until it can be practised in-doors.

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EXPOSURE IN THE CAMERA.

Exposure in the camera.

(53.) In selecting a view for a photographic picture, much care, judgment, and skill, should be exercised; and in the hands of one who possesses an artistic feeling, the results are often truly beautiful. In varying the attitude in a portrait, or the point of view in an architectural subject, or a landscape, the artist will select such as are most conducive to picturesque treatment, equally avoiding large masses of strong sunlight or deep shadows. A sky in which the sun is obscured by large white clouds is the most favourable. Violent contrasts of light and shade are not suitable for photographic views; they give a heavy, blotty appearance, the contrast between the lights and the shadows being too powerful. It is only in the hands of a true artist, or man of taste, that pleasing results may be looked for. He who proceeds mechanically in his task may, by a fortunate accident, produce a good picture; and we have abundant evidence to show us that the mechanical treatment of nature is the most common and the least successful. It is in the hands of artists that photography will attain its highest excellence, to whom the attainment of *effect* is intuitive, while they themselves will acquire much valuable instruction from studying its results. Not-

Selection of view.

Violent contrasts to be avoided.

Artistic treatment required to produce a good result.

withstanding the microscopic accuracy of detail presented by a good photograph, its chief value and excellence will be found to consist in its neutralising certain details, and in its representing *masses* of light and shade, the more striking and curious from being devoid of colour. In this country, at present, the value of these productions, in an artistic point of view, is scarcely recognised; while in France, Italy, Germany, and America, they have long ago occupied the portfolio of the *cognoscenti*, and the studio of the artist.

Near objects must be in the same vertical plane

(54.) If the view selected to be taken consists of near objects, such a position should be chosen as will present all the objects included in the view as nearly as possible in the same vertical plane; for if the focus of the lens is adjusted to a distant object, the near ones will be confused and distorted. With a lens of long focus adjusted to distant objects this defect is diminished. It is always better to focus upon the near objects than upon the distant, for if the latter appear a little indistinct in the positive picture, it only adds to the effect of aërial perspective.

Regard must be had to the colours of objects.

(55.) The colours of the objects in the view must be taken into consideration,—remarking, that blue and its hues, white, and violet, operate more upon the sensitive surface than green, red, orange, or yellow: if violent contrasts of these colours

present themselves unfavourably, the point of view should be changed.

Sensitive paper must be placed in the exact focus.

(56.) The focus carefully adjusted, it only remains to place the sensitive paper exactly in the same place occupied by the ground-glass upon which the image was received. When this is once correctly ascertained, no further concern need be taken respecting it. We only mention it, because in some cameras, "made to sell," no care is taken to adjust this plane. The interior of the camera should be kept scrupulously clean, any particles of dust in it carefully wiped out; the lenses, also, should be wiped with a piece of wash-leather, and the camera placed in "position" before a picture is taken, so that its temperature may become uniform with that of the surrounding medium. If it should happen to be colder than the atmosphere, a deposit of moisture may form upon the lenses and the glass of the frames, by which a complete obscuration of the image would occur.

Temperature of the camera to be equalised with the atmosphere.

Lenses.

(57.) The lenses of the camera are placed at the extremities of two tubes, traversing within the camera, for the purpose of adjusting the focus. Two lenses, each of long focus, when placed together, or nearly so, produce an image at a shorter focus than either would separately, and with a greater concentration of light at the focus, but the image is of smaller dimensions: this property

NEGATIVES.

renders the employment of two lenses favourable for taking portraits. For landscapes and views, a single lens, either compound (*achromatic*) or simple, is generally preferred; for if there is less intensity of light, this deficiency is compensated for by diminished spherical aberration (15).

Lenses, single or two-fold arrangement.

On the employment of diaphragms, see (17).

(58.) If the operator requires to take both portraits and views, it is convenient to have two cameras, one much smaller than the other: that for portraits need not be larger than will admit of its carrying a frame of 7 inches by 5, or thereabouts. That for landscapes, &c., may be 15 to 18 inches, by 10 to 14, according to the power of the lens. One set of lenses may be made to serve for both cameras, a single lens for views, the two-fold arrangement for portraits: but with this precaution, whereas in taking portraits the *convex* side of the lens is presented to the object; for views, the concave side must be turned in that direction, and the back lens taken out.

Meniscus, the best form when only one is used.

(59.) If the lens employed is a simple one of the best form (*meniscus*), it will be necessary, after adjusting it to the apparent focus, to move the frame that carries the ground-glass a little nearer to the object, in order to place it in the chemical focus, where the action on the sensitive paper takes place.

(60.) It is not possible to give any rules for the length of time the prepared paper should remain

NEGATIVES.

Time of exposure in the camera governed by various circumstances.

exposed to the action of light in the camera. This exposure is governed by,—

1. The amount of light illuminating the object taken.

2. The colour and distance of that object.

3. The degree of sensitiveness possessed by the prepared paper.

4. The size of the aperture in the diaphragm.

(61.) With paper prepared according to the preceding formula, and a lens of twelve inches focal length, and a diaphragm with an half-inch aperture in front of it, five minutes or less on a bright day will suffice; but on a dull gloomy day, fifteen to twenty minutes may be requisite. We are sanguine in our belief that photography on paper will not stay its progress until it produces a sensitive surface, and a developing agent, which will yield an image on an instant's exposure.

(62.) With a double (twofold) lens, and paper prepared as directed, a portrait may be obtained on a clear, bright day, in thirty to sixty seconds.

(63.) After the paper has been exposed in the camera so long as may seem necessary, it must be removed to the dark chamber, to be submitted to the developing agent; for as yet no impression is visible upon its surface. To avoid disappointment, it will be advisable, in commencing, to take two or three proofs of the same view, with different degrees of exposure in the camera.

DEVELOPMENT OF THE IMAGE.

(64.) Take a clean dish, capable of containing half an inch in depth of fluid, and pour into it sufficient of the following solution to completely cover the paper:— Developing the pictures.

Distilled water . . .	1 pint
Gallic acid	20 grains

Mix and filter, then add

Silver solution* . . .	1 oz.

(65.) Immerse the proof completely in this solution, and watch its progress at intervals: if the time in the camera has been well considered, the development will take place in ten or fifteen minutes; otherwise it may require many hours. As soon as the image is fairly out, remove the proof to a porcelain or glass slab, and wash it freely, rubbing a camel's-hair pencil or finger lightly over the back of the proof, to remove any crystalline deposit which might leave spots. It must then undergo the "fixing" operation, which is effected by dissolving out the unchanged Iodide of Silver with hyposulphite of soda (146).

* The water used for washing the sensitive paper before mentioned (48).

NEGATIVES.

Test of the time of exposure.

(66.) The appearance of a proof after development will serve to guide the operator as to the length of exposure in the camera. If the time has been too short, the appearance of half-tones in the proof will be feeble and indistinct. If the exposure has been too long, or the quantity of light admitted into the camera too great, the whole proof will become darkened, sometimes unequally; in which case, the time of exposure for the next picture must be abridged, or the aperture of the diaphragm diminished.

(67.) If the time of exposure has been too short, the defect may frequently be completely remedied by leaving the proof in the developing-bath a longer time. It would appear that an action is set up in the salt of silver the instant the rays of light fall upon it; and could we but find appropriate agents for developing, this instantaneous exposure in the camera with prepared paper would be as effectual as it is with iodized collodion. But the longer, within certain limits, the paper remains in the camera, the quicker the developing process can be performed. For instance, if one sensitive paper is exposed in the camera twenty seconds, and another fifteen minutes, the first will, perhaps, require a day and night's immersion in the gallic acid developing solution, while the latter will be fully developed in an hour.

(68.) The action of the gallic acid is accelerated if the solution be warmed before the proof is immersed in it. On paper.

(69.) Pyrogallic acid, very dilute, may also be used for developing, its action is more energetic than that of gallic acid, particularly with the addition of a few drops of nitrate of silver.

FIXING THE NEGATIVE PROOF.

Fixing the proof by removing the iodide of silver with hyposulphite of soda

(70.) The object of this operation is to fix the impression on the paper, by removing the iodide and other salts of silver, after washing the proof in clean water. Most of these salts are insoluble in water: we have, therefore, to seek a convenient solvent,—one which will dissolve them, and at the same time not injure the impression already depicted on the paper. Nothing has been found better adapted for this purpose than the hyposulphite of soda (146). Take

Filtered rain or river water . .	1 pint
Hyposulphite of soda . . .	2 ounces.

Pour a sufficient quantity of this into a dish, and immerse the proof in it, watching carefully the disappearance of the iodide from its surface, which can be ascertained by the disappearance of the yellow tint. This will take from a half to three-quarters of an hour, in some instances; but, with well-waxed paper, ten to fifteen minutes will be found sufficient. The change the proof undergoes in this operation is quite marvellous; the "darks" appear of an intensity, and the "lights" of a brilliancy, truly astonishing.

(71.) The hyposulphite solution should be filtered after each proof has been fixed: it will serve

many times, but only one proof at a time should be placed in it.

(72.) The proof should next be placed in a dish of clean water, frequently changed, and washed with a camel's-hair brush; and after being immersed for some hours, rinsed in several waters, and hung up to dry. It is now unalterable in the light.

To restore the transparency of the proof.

(73.) If the waxed paper loses its transparency, and presents a mottled appearance, as it generally does at this stage of progress, it must be held before the fire until warmed, then placed between two sheets of blotting-paper, and a warm smoothing-iron passed over it. This will completely restore its transparency.

We call these proofs *Negatives*, because, as in all pictures obtained in the camera, the images of objects are reversed in position, and, moreover, the dark parts are light, and the light parts are dark, relatively to nature. We employ these negatives to obtain by the printing process any number of positives, in which the effects of light and shade are again reversed, and objects appear in the position they occupy in nature.

THE WET METHOD.*

(74.) Paper prepared with the salts of silver is more sensitive in the humid state than when dry, but the wet method can scarcely be carried on out-of-doors away from the resources of the operating-room; yet where circumstances will admit of its being employed, very fine results can be obtained. The paper is prepared in the same manner as in the dry process, and may be either waxed or unwaxed. The wet process.

(75.) 1. Immerse the papers in the solution of iodide of potassium, and dry them.

2. Float them upon the aceto-nitrate solution for about ten minutes.

Have ready a sheet of glass which fits accurately to the frame of the camera, and lay upon it a piece of smooth white blotting-paper, previously dipped in clean water: this is to receive and to keep moist the sheet of *sensitive* paper, which must be carefully laid upon the blotting-paper, sensitive side

* See Appendix.

NEGATIVES.

Wet method. uppermost, of course; it is best to pour over the blotting-paper a gentle stream of water, so as to float the sensitive paper, and by carefully tilting the glass-plate, allow the excess of water to drain off. When the water ceases to drop, the glass-plate, with the sensitive paper, may be removed to the camera and exposed to the image in the focus of the lens.

Some practitioners place this wet sensitive paper *between* two plates of glass while in the camera; but there is no necessity for so doing, while at the same time, there is risk of disturbing the true focus.

3. The necessary exposure in the camera being completed, the views are to be *developed* by the saturated solution of gallic acid with the aceto-nitrate, as described in the dry method (64).

4. The *fixing* is accomplished in the ordinary manner, by the solution of hyposulphite of soda, and the negative proof can then be waxed (70).

POSITIVES.

THE PRINTING PROCESS.

POSITIVES.

Preparation of Positive Paper.

(76.) The paper for positives must be selected with the greatest care; every sheet containing holes or spots should be rejected. We give the preference to a good thick English paper, not too highly glazed.* Cut it the required size, and make a pencil-mark at the corner on the back. Then pour into a clean porcelain dish the following solution:—

Distilled water	1 pint
Chloride of ammonium . .	1 drachm.

Immerse in this solution about twenty sheets of paper, one after the other; after soaking a few minutes turn the mass, so that those which were uppermost become undermost, after a while suspend each sheet singly on a line to dry, the back previously marked with a pencil will be easily discerned.

* Towgood's paper does not require to be prepared with chloride of ammonium, but is floated at once upon a 60-grain solution of nitrate of silver.

Positives.

Preparation of the paper

(77.) It is now impregnated with chloride of ammonium (127), and is termed *salted paper;* it may be kept in this state for any length of time. The object of this preparation is to produce a chloride of silver, by decomposing the nitrate of that metal in the next stage of the process, which must be performed by yellow light.

Have ready another dish, into which pour sufficient of the following solution to cover the bottom:—

Distilled water . . .	1 ounce
Nitrate of silver . . .	60 grains.

Place upon it a sheet of the paper prepared as above directed, first rubbing it with a piece of blotting-paper to remove any crystals of the chloride, carefully avoiding to wet the back; as soon as the fluid applies itself uniformly to the paper, lift it off, and hang it up by one corner to drain, and when dry preserve it for use in a portfolio, pressed between leaves of blotting-paper.

(78.) Paper thus prepared will remain white some six or eight days: after that time it generally begins to turn brown, it is therefore better to use it soon after it is prepared. Paper submitted to the first solution can be kept any length of time before being submitted to the silver solution. The second stage of preparation had better be performed the evening before the paper is required for use.

(79.) A quicker mode of preparing this positive paper is by coating it with the ammonio-nitrate of silver, as suggested by Dr. Alfred S. Taylor, as follows:—Make a solution of nitrate of silver, of the strength of thirty-five grains to the ounce of distilled water; add to it gradually, drop by drop, a strong solution of ammonia, a copious precipitate falls; continue to add the solution of ammonia until this precipitate is just re-dissolved: the paper is floated upon this solution as directed for the other (76).

Dr. Taylor's method.

I prefer paper prepared with Albumen (80).

Albumenized Paper for Positives.

Albumenized paper.

(80.) Albumenized Positive Paper.—Positive proofs taken upon paper coated with a film of albumen (119) attain a brilliancy of effect by a softening of the glaring white of the lights, with a transparency in the shadows, which cannot be arrived at by any other means. They are defective only when the albumen is applied too thickly.

Formula for first process.

Take of

Whites of eggs . . .	8 ounces
Distilled water . . .	8 ounces
Chloride of ammonium .	30 grains.*

Beat the whole together into a froth with a wooden spoon or fork. Take the froth as it runs, and put it into a basin; let it settle for twenty-four hours, and strain through fine cambric. It is then fit for use. I have found the addition of four minims of glacial acetic acid to the white of each egg, after dilution, to effect a remarkable improvement in the preparation of albumen, which becomes perfectly free from flocky particles and quite transparent under the influence of the acid. Pour sufficient quantity into a dish, and float a sheet of paper upon it for three or four minutes; hang it up to dry thoroughly; then

* French paper is particularly well adapted to receive albumen.

place it between two sheets of glazed paper, and pass a smoothing-iron, moderately heated, over it: keep in a portfolio for use.

Formulæ for second process.

(81.) Paper thus prepared is excited by placing the albumenized side upon a bath containing the following solution:—

Distilled water . . .	1 ounce
Nitrate of silver . . .	60 grains.

Let it remain in contact about four or five minutes; then hang it up to dry, and preserve it out of the influence of light.

(82.) The formula I now employ is as follows:—

Distilled water	1 pint
Chloride of ammonium . .	18 grains.

Immerse the sheets of paper in this liquid, and dry them: then brush them over with the following:—

Distilled water	1 ounce
Nitrate of silver	38 grains
Solution of ammonia . . .	q. s.

The longer it has been made the better it answers.

Positives.

PRINTING PROCESS.

Positive Proofs.

Printing process.

(83.) To obtain a good positive proof is the aim and end of all our previous operations. Success in this result demands that the negative should be as perfect as possible. The process has been called *printing*, perhaps as good and as expressive a name for it as any other. The pressure-frame, or printing apparatus, consists of a frame fitted with a thick plate glass, and a wooden back hinged in the middle, with screws capable of exerting considerable pressure by which the negative proof is brought into close contact with the positive paper.

(84.) Place the back of the negative proof upon the plate of glass in the pressure-frame. Then lay upon it the positive paper, the prepared side upon the face of the negative, and cover it with a piece of black velvet or cloth: carefully ascertain that no grit is between, else the glass may be broken, then shut down the wooden back, apply the screws, turn the frame up, and expose it to the diffused light of day. In order to ascertain when it is sufficiently darkened, a piece of the positive paper should be allowed to project beyond the negative, and by watching the changes in this, a tolerably safe conclusion may be arrived at, or a portion of the

hinged back can be turned over, and the proof quickly examined.

The proof must be allowed to remain in the pressure-frame, and exposed to light until the lights are many tones deeper than they are intended to remain subsequently; the necessity for this consists in the fact that, in the subsequent operation of *fixing*, the hyposulphite of soda attacks the "high-lights," and either destroys their delicate details, or effaces them altogether, while it at the same time brings out all the detail of the shadowed parts with an amount of depth of tone that heightens the degree of contrast between them and the lights, producing a spotted appearance: therefore, by continuing the printing until the lighter parts appear too dark, we obtain the proper gradation to ensure an effective picture.

(85.) In this climate, where sunlight cannot often be reckoned upon, it becomes exceedingly desirable that the positive paper should possess a high degree of sensitiveness. That prepared with the ammonio-nitrate of silver, as suggested by Dr. Taylor, appears to be more sensitive than any other we have employed (79). It is, however, not a safe substance to recommend to those unacquainted with chemistry.

The Toning-bath.

Toning.

(86.) When the proof appears sufficiently printed, remove it into the darkened chamber, and immerse it immediately in the following solution:—

Hyposulphite of soda . . .	1 ounce.
Saturated solution of iodide of silver in hyposulphite of soda . .	2 grains.
Blackened chloride of silver . .	15 grains.
Water, distilled or rain . . .	6 ounces.

(87.) The positive proof being placed in the above mixture, will acquire almost any degree of dark tone that may be desired, from red-brown to violet or black; to ensure the latter, some chloride of gold, greatly diluted, may be added drop by drop to the hyposulphite of soda, keeping it constantly stirred. A little practice will make the result easy and sure of attainment. The longer it has been exposed in the pressure-frame, the longer it requires the toning-bath, and the deeper will be the colour.

(88.) Heating the hyposulphite solution will accelerate the operation of toning, so will the addition of a few drops of acetic acid; but their employment is attended with some risk, and where the proof is of value should not be attempted.

FIXING THE POSITIVE PROOFS.

Fixing the positives.

(89.) When the proof has attained the tone desired, remove it from the solution, and immerse it for ten minutes in a bath of clean hyposulphite of soda, of the following strength: —

Hyposulphite of soda . .	1 ounce.
Water	8 ounces.

Remove it, then wash it under a stream of water, and soak it for twelve hours in abundance of water, frequently changed, until it becomes tasteless; the hyposulphite of silver is intensely sweet, and the smallest quantity may be detected by the tongue. It is of the utmost importance to remove every trace of the "hypo," for if any is allowed to remain, the proof gradually fades away and is destroyed. Hang the proofs by one corner to drain, press them then between sheets of blotting-paper, or dry them in the air, and smooth them with a warm flat-iron: albumenized paper, if left too long in the toning-bath, becomes yellow in the lights.

(90.) If the positives have not been taken upon albumenized paper, they can now be washed with a mixture of equal parts of white of egg and distilled water, applied with a flat camel's-hair brush. When

Positives.

dry, place them between two pieces of glazed paper, and pass a hot smoothing-iron over, which will render the albumen insoluble.

(91.) The rich dark violet tint, so much admired in many French pictures, is derived from the use of sel d'or, or hyposulphite of gold and soda (129).

PROCESSES ON GLASS.

Collodion and Albumen.

(92.) Materials.

Plates of Glass to fit the slide of the camera. A pure white glass has lately been manufactured for photographers, which will be found to possess many advantages. The glass plates must be perfectly flat, without scratches or air-bubbles. Beginners who buy large cameras are advised to purchase frames fitting into the slides which will carry smaller plates of glass: as they are more easily operated with, and less collodion is wasted.

Bath of Glass or of Gutta Percha, to contain the nitrate-of-silver solution, in which the glass plates are plunged. The bath must be a little larger than the plates.

Glass Dipper, with which to hold the glass plate when dipped into the bath.

A large Dish, or Sink, over which the washing operations may be performed.

Levelling Stand, on which to lay the glass plate during some of the operations.

A Pair of Scales with Glass pans, with grain, scruple, and drachm weights, with which to weigh the chemicals.

Glass Measures, graduated from 1 oz. to 3 oz. or more, to measure the quantities of water, &c.

Glass Measures, small, graduated from 60 to 120 minims, with which to pour on the developing mixture.

Glass Rods, to stir the various mixtures.

Glass Funnels, for filtering.

Bibulous Paper, for filtering.

Plate Boxes of different sizes, in which to deposit the various-sized plates when the images are fixed.

A Thermometer.

(93.) Chemicals.

Collodion, Iodized (136).—A four-ounce bottle will suffice for many experiments. It is advisable to have also a wide-mouthed phial for constant use, of sufficient capacity for one day's operations—replenishing this from the larger bottle.

Nitrate of Silver (155).—Six ounces of crystallized nitrate of silver will suffice for many experiments.

Glacial Acetic Acid (118).—A bottle containing three ounces.

Pyrogallic Acid (157).—Two drachms.

Hyposulphite of Soda (146).—Half a pound.

Cyanide of Potassium (137).—Two ounces.

Ether (138).—Two ounces.

Alcohol (120).—Four ounces.

Nitric Acid (156).—One drachm, mixed with nine drachms of water.

Distilled Water.—A two-gallon bottle.

And for variations of the Collodion process:—

Proto-sulphate of Iron (181).
Bromide of Potassium (123).
Nitrate of Magnesia (152).
Nitrate of Baryta (151).
Nitrate of Potash (152).
Glucose, or Grape Sugar (143).
Tartaric Acid (161).
Formic Acid (141).

A few Practical Hints on the Collodion Process.

(94.) Ascertain that the frames are accurately adjusted to the focus of the lens. If a difference exists between the apparent and the chemical foci of the lenses, they should be rejected, as no certainty in obtaining a clear picture will ever be secured.

Be very careful that the glass plates are *perfectly* clean; more failures arise from want of care in this respect than from any other cause.

Keep the nitrate-of-silver bath covered up when not in use. The slightest impurity in it may spoil a good picture.

Remember that nitrate of silver blackens almost everything it touches. The fingers will soon exhibit stains, which can be removed by washing with cyanide of potassium.

Be careful, in weighing or measuring, that the scales or measures are quite clean. After each operation they must be carefully wiped.

Be sure that no light, except the yellow light of the operating-room, falls upon the plate from the time it is taken from the nitrate bath until after it is developed. Some operators even cover up the slide in a little bag while removing it from the room to the camera.

It is best to expose the plate in the camera as soon as possible after it leaves the bath; but it may sometimes be necessary to carry it a short distance, which must be done as quickly as possible, so as not to allow time for the plate to dry; and upon returning, plunge it again, but for a fraction of a second only, into the nitrate-of-silver bath.

Common cistern or river water is full of impurities, which would decompose many salts if dissolved in it. If distilled water cannot be got, clean ice melted produces very pure water; and boiled rain-water, filtered, may do as a substitute.

The developing solution should always be filtered, and placed out of the reach of splashes. It will remain useful for many days.

COLLODION PROCESS.

THE theory of the Collodion Process is identically the same as that of the Processes on Paper, wet or dry: its superiority consists in its yielding an image with infinitely greater rapidity upon exposure to light.

COLLODION NEGATIVES ON GLASS.

COLLODION NEGATIVES ON GLASS.

(95.) Collodion is gun-cotton (xyloïodine) or paper dissolved in ether mixed with alcohol containing an alkaline iodide (135). When poured upon a plate of glass it runs freely over the surface, and the ether and alcohol evaporating, leave the collodion behind in the state of a tough transparent film; dipped into a solution of nitrate of silver, photographic images can now be taken upon it. In Section (136) is given the process for preparing iodized collodion, but it will usually be found more convenient to buy it ready prepared. By the use of this liquid we are now enabled to obtain the impression of an image by an instantaneous exposure to daylight.

(96.) The glass plates, cut accurately to the required size to fit the frames, must be carefully selected; let them be as free from colour as possible, and devoid of specks and scratches, which would produce blemishes on the proofs taken from them.

Selection of the glass plates.

The first important operation in the collodion process is that of *cleaning the glass plate.*

Cleaning them.

(97.) First lightly dust it, to remove any gritty particles, then pour upon it a small quantity of a solution of cyanide of potassium, and rub it all over with a piece of cotton wool or bibulous paper; then rinse it in an abundant stream of water, wipe it, and with another cloth dry it completely, and then polish it with a piece of wash-leather kept for the purpose.

The cyanide of potassium is free from the disadvantage attendant upon the use of nitric acid and ammonia, as the fumes they give forth in the operating-room are very prejudicial.

(98.) *Coating the Plate with Collodion.*—Having arranged everything ready for use for ordinary-sized plates, i.e. 5 by 4 inches, fill a *clean* two-ounce stoppered bottle with iodized collodion (taking care not to disturb the sediment which accumulates at the bottom some hours after iodizing, as it would produce *transparent* spots in the proof), proceed to cleanse the mouth of the bottle from the dry crust of collodion which accumulates

Coating the plate.

Negatives on Collodion.

around it; hold the glass plate between the thumb and finger of the left hand by one corner, pour upon it as much collodion as it can conveniently hold, then cause it to flow successively to each corner, avoiding, if possible, that by which it is held, and finally pour off the surplus at the *free* corner nearest the body of the operator into the bottle, keeping up a jerking, oscillatory movement, until it ceases to drip; then, holding the plate still in the same position, replace the stopper, and wait until the collodion appears sufficiently set, which may be known by the disappearance of a series of diagonal lines at first very apparent: this usually takes place within half a minute or more, according to temperature. This operation may be conducted by daylight, the following only in a dark room:—

Immersion in a Bath of Nitrate of Silver.

The nitrate of silver bath.

(99.) This bath is composed in the proportions of 30 grains of nitrate of silver to an ounce of water—or take

Nitrate of silver in crystals . .	10 drachms,
Distilled water	20 ounces;

and must be filled so as to *entirely* cover the glass plate when it is dipped in. The solution must be filtered through blotting-paper, and when not in use kept in a glass-stoppered bottle. The tempe-

rature of the operating-room and chemicals should never be allowed to fall below 50° Fahr.

Nitrate of silver bath. Its action on the Collodion

(100.) We may in this place opportunely introduce some remarks on certain conditions of the bath, which frequently cause much trouble to operators, unless their cause and remedy are understood.

Crystallized nitrate of silver dissolved in water possesses the property of dissolving the iodide of silver; now as the result of plunging a film of *iodized collodion* into that liquid is the deposition of this iodide thereupon, it will be easily imagined that it is necessary to saturate the bath therewith previous to using it. Mr. J. B. Hockin has observed, that although so saturated, the best effect is not obtained from the bath until after many plates have been immersed; he, therefore, advises that half an ounce of iodized collodion be mixed with each pint of silver bath, and after being agitated therewith some time, and allowed to macerate twelve hours, it may be filtered off, and tested (102). From this it would appear that certain other constituents of the film (xyloïodine) are soluble in the bath.

(101.) Take the glass plate coated with collodion, lay it with its back upon a glass dipper, and at one motion plunge it into the bath. Should there be any hesitation or delay, a streak will certainly be formed across the collodion, which will render the plate

NEGATIVES ON COLLODION.

useless. The plate must be allowed to remain in the bath about two minutes, to effect a combination between the iodine and the silver; it should then be quickly raised out of the bath, and dipped back again two or three times. This helps to get rid of a certain greasy appearance. The plate is then taken out, allowed to drain on blotting-paper for half a minute, and then shut up in the camera-slide, and immediately taken to the camera. If, however, it is necessary to carry the prepared plate to a considerable distance, it is advantageous to cover the film of collodion with another clean plate of glass, which will prevent the moisture evaporating; it is necessary, however, to have a slide capable of holding both glasses, prepared expressly for this purpose.

It has lately been discovered that the collodion can be rendered sensitive for several days by the following operation:—When the plate is taken from the nitrate-of-silver bath in the usual way, let it drain upon blotting-paper, and then pour upon its surface, two or three times, sufficient to cover it of the following solution (*filtered*):—

Honey . . .	3 ounces.
Distilled water . .	5 ounces.

Stand the plate up to drain for a few minutes, then shut it up in the slide, and it will remain sensitive for several days.

(102.) Nitrate of silver is very rarely free from a slight excess of nitric acid, which has a very injurious effect in the subsequent operations, retarding the sensitiveness in a very eminent degree. The liquid should be tested for it by blue litmus paper; if there be much acid, the paper turns red as soon as brought into contact with it; this condition must be changed by the cautious addition of a few drops of *ammonia, diluted with one hundred times its bulk of water,* until it is found that it requires an immersion of the test-paper for at least half a minute, to produce a very *slight reddening* in it. This fact, however trivial it may appear, should be kept in view by the photographer, upon its due observance much of his success will be found to hinge.

Acidity and alkalinity of the bath to be corrected.

In some collodions this state of acidity is exalted, in others it is diminished; in each case the remedy is obvious—*one per cent liquor ammonia,* or *one per cent nitric acid,* should be kept in the operating-room for the purpose. In no case should the amount of nitric acid exceed $\frac{1}{20}$th minim per pint of twenty ounces.

This condition accounts for certain collodions becoming speedily changed in colour to reddish-yellow a day or two after being iodized: such are inconstant in their operation. A collodion should be preferred which, after it has been iodized several weeks, does not pass beyond a pale straw-colour.

EXPOSURE IN THE CAMERA.

(103.) The collodion-covered plate is now ready for exposure in the camera, the focus having been previously adjusted. If the operator is unacquainted with the use of the camera, he should obtain directions from the person of whom he purchases it, as no written instructions can clearly explain how to adjust the camera on the tripod, how to obtain the focus for a portrait or a view, or how to expose the sensitive surface.

(104.) Collodion is now prepared of such high degree of sensitiveness, that impressions can be made upon it in an instant, if the light is strong and the object well illuminated; at other times, on a dull, cloudy, or rainy day, it may require from ten to thirty seconds. By practising daily upon the same object at the commencement of operations, we can obtain a test by which subsequent efforts may be guided. Much depends upon the quality of the collodion, the power of the lens, and the intensity of the actinic power of the light.

DEVELOPING.

(105.) Having allowed the collodion plate to remain exposed for the time considered sufficient, place the cap on the lens, shut up the slide, and with all expedition carry it to the operating-room, and lay the plate upon the levelling-stand, which is placed in a sink or large basin, where the image which is latent can now be developed. Developing

Developing can be accomplished by pyrogallic acid, by sulphate of iron, or by nitrate of iron. by

(106.) The agent usually employed for negatives is a solution of pyrogallic acid, which is made as follows:— Pyrogallic acid.

Distilled water .	. 12 ounces
Pyrogallic acid .	. 9 grains
Glacial acetic acid .	. 3 drachms.

Dissolve and filter.

Sufficient of this mixture to cover the collodion plate must be taken in a small measure, (a plate 5 inches by 4 requires about 3 drachms), and poured gently over the surface, quickly, and not all in one spot, but carried over so as to be diffused as soon as possible. The fluid must be kept in motion by blowing it over the surface, to prevent the picture being stained. The plate must be watched carefully so as to stop the action as soon as the image is well developed, and a gentle stream of

Negatives on Collodion.

Developing by water poured over it to remove the decomposed liquid as quickly as possible. In cold weather it is advisable to add to the pyrogallic acid a few drops of nitrate of silver from the bath. As this process is performed the image will be seen gradually to appear upon the surface of the collodion, and we are then able to judge of our success. By holding the plate over a piece of white paper, it will be seen how far the image is developed.

Proto-nitrate of iron. (107.) Another method of developing is often used, viz. by proto-nitrate of iron. By this process a bath is used which will serve for a number of operations. It is prepared as follows :—

Boiling distilled water . .	6 ounces.
Protosulphate of iron . .	240 grains.
Dissolve.	
Nitrate of barytes . . .	225 grains.
Distilled water . . .	6 ounces.

Dissolve, mix with the other solution, allow the deposit to subside, then add to the

Clear liquid	6 ounces.
Glacial acetic acid . . .	3 drachms.*

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* Other formulæ—

Protosulphate of iron . .	20 grains.
Distilled Water . . .	2 ounces.
Diluted nitric acid . . .	10 minims.
Glacial acetic acid . . .	40 minims.

Or,

Nitrate of potash . . .	102 grains.
Sulphate of iron . . .	140 grains.
Glacial acetic acid . . .	2 drachms.
Water	6 fluid ounces.

Poured over the proof in the same manner as the pyrogallic acid.

Filter this solution, and pour sufficient into a bath, either of glass or gutta percha, to cover the plate entirely when immersed; plunge the proof in, and the image will appear in three or four seconds. If the impression is too faint, it can be strengthened by pouring over it a solution of gallic acid containing a few drops of nitrate of silver, which will greatly improve it.

(108.) If the proof has a grey tone all over it, the exposure in the camera has been too long; if, on the contrary, the light parts in the object remain black, it shows that the exposure has been too short.

NEGATIVES ON COLLODION.

FIXING THE PROOF.

"Fixing"

(109.) The 'fixing' of the proof, by which is meant the means by which it is rendered permanent and no longer susceptible of the action of light, consists in washing it with certain solutions, which will dissolve the salts of silver remaining on the plate; this result can be effected by hyposulphite of soda, and by cyanide of potassium, preference should be given to the latter, as the accidental mixture of the former in any of the solutions is productive of much mischief:

by

Cyanide of potassium

Cyanide of potassium . .	60 grains
Rain water	3 ounces.

or by

or, if the hyposulphite is preferred:

Hypo-sulphite of soda.

Hyposulphite of soda . .	4 ounces
Rain water	10 ounces.

Pour sufficient quantity of either of the above over the proof until all cloudiness is removed. Then wash it in an abundant stream of water to remove every trace of the salt, but taking care that none flows between the film and the glass plate.

Place it upon a levelling stand, and pour upon it as much water as it will contain, let it stand about ten minutes, then set it on an edge to drain, and let it dry spontaneously, or it may be dried by the aid of heat from a fire or a spirit-lamp.

When the washing is not effectual, so as to completely remove every trace of the 'fixing' solutions, the surface becomes partially or wholly covered with arborescent crystals which effectually ruin the proof.

(110.) *Varnishing.* When dry, to prevent injury from friction, the proof must be varnished with *amber* varnish (162); if it is a negative, it is then ready for taking any number of positives from; if it is a positive (163), it should be *backed* with patent jet, Brunswick black, or velvet, as suggested by Sir John Herschel (111). Varnishing.

POSITIVES ON COLLODION.

(111.) These resemble in many respects Daguerreotypes, but are free from the objectional glare peculiar to the polished silver plates.

For direct positives the method of coating and exciting the sensitive surface is the same as that employed for negatives. After exposure in the camera, as for negatives, the developing process is conducted with either pyrogallic acid, proto-nitrate, or protosulphate of iron, with or without the addition of nitric acid. Various formulæ have been suggested; the following will be found as useful as any:—

Developing.

Formulæ.

Pyrogallic acid . .	8 grains
Distilled water . .	8 ounces
Acetic acid . . .	2 drachms.

When mixed, add one or two drops of dilute nitric acid, according to its strength. Mix and filter. Or,

Distilled water	1 ounce
Protosulphate of iron . . .	10 grains
Acetic acid	½ drachm
Dilute nitric acid (1 acid to 10 water)	3 to 5 drops.

Either of these developing solutions must be applied by quickly covering the whole surface of the glass plate with the fluid, as they act so ener-

Positives.

getically that if any delay occurs the resulting proof will present a mottled appearance.

Developing.

As soon as the picture is visible, or, as soon as it *begins* to appear, the developing solution must be poured off, and the proof well washed with water, and then fixed in the usual manner by cyanide of potassium. If the developing were continued longer the picture would become a *negative*. In drying it loses its transparency, but this can be restored by varnishing.

Consequences of insufficient exposure in the Camera.

When the picture developes very slowly, it is due to insufficient exposure in the camera; in consequence of which the shadows, instead of being strong and even, are covered with a multitude of spots of metallic silver, which extend gradually over the whole plate. This effect is due to the spontaneous decomposition of the nitrate of silver and the developing solution.

When backed with black varnish, these positives have a very brilliant appearance, with the advantage of being in position non-inverted (163).

ALBUMEN ON GLASS.

Albumen on glass.

(112.) THEORETICALLY this process is the same as the preceding; like collodion, albumen is but the *vehicle* or medium for the sensitive agents, and it possesses the property of becoming insoluble in water upon the application of heat. The application of this substance to photography on glass is due to M. Niepce de St. Victor.

(113.) Take the whites of eggs, and to every 100 grains add 1 grain of iodide of potassium, or of iodide of ammonium. Beat the whole into a froth; leave it all night to settle; decant the clear liquor, and, if necessary, strain through fine cambric.

Take a thin piece of plate glass—if ground on the border of the surface it is preferable, because the albumen will adhere better; clean it well with distilled water, rub it dry with a piece of tissue paper, and finish with a piece of cotton wool.

Place it on a stand perfectly level; then pour over it freely the albumen, until the plate is quite

NEGATIVES.

Albumen on glass.

covered. Take it in the hands, and so incline it that an even layer of the greatest thinness possible shall be spread over its surface, and replacing it upon the horizontal stand, put it away in a box or closet out of the reach of dust.

(114.) Before putting the albumenized glass into the bath of aceto-nitrate of silver, it must be held before the fire until every trace of moisture is removed. The application of the bath is a very delicate operation, for the least hesitation in plunging the glass plate into the fluid will cause irregularities on the surface, which nothing can remove. Fill the bath about two-thirds with the following solution:—

Distilled water . .	5 drachms
Nitrate of silver . .	24 grains
Acetic acid . . .	30 „

Let the albumenized plate remain in two or three minutes; then remove it, wash in distilled water, and dry in the dark.

The albumen plates thus prepared can be preserved one or two days before exposing them in the camera.

Developing by gallic acid.

(115.) The image can be developed in the same manner as negatives on paper, putting the plates into a warm bath of gallic acid containing not more than one-sixteenth of its volume of aceto-nitrate of silver.

Developing by proto-sulphate of iron.

(116.) We obtain much more rapidity by developing the image with a bath of saturated solution of protosulphate of iron, containing one-sixteenth of glacial acetic acid.

Fixing.

(117.) The time in the camera may thus be diminished three-fourths. When it is well developed it can be fixed by hyposulphite of soda, washed, and dried.

DESCRIPTION OF THE CHEMICALS USED IN PHOTOGRAPHY.

CHEMICALS USED IN PHOTOGRAPHY.

(118.) Acetic Acid. Glacial or Crystallizable. ($C^4 H^3 O^3 H O$)

(Equivalent, 60 = C 24 + H 4 + O 32)

This acid is prepared from the decomposition by sulphuric acid of acetate of soda obtained from the impure pyroligneous acid of commerce. It is employed in photography, added to a solution of nitrate of silver (*aceto-nitrate of silver?*) to prevent too great rapidity of action in the substances used as developents, and to cause them to flow freely, as well as to assist the penetration of the solutions into the paper.

A sheet of iodized paper placed upon the solution of aceto-nitrate of silver gives rise to the following decomposition: the iodide of potassium is decomposed by the nitrate of silver, the silver combines with the iodine on the paper, and forms an insoluble iodide of silver, which may possibly include a little acetate of silver, and the potash of the iodide forms nitrate of potash in solution.

Acetic acid is useful to remove spots on the negative proofs formed by the oxide of silver. Added to the mixture of albumen and water for positive paper it clarifies the fluid (80).

(119.) Albumen.

This substance is readily obtained, the whites of eggs consisting of that principle. When thinly spread upon a glass plate, and exposed to evaporation, it dries up to a pale yellow gum-like substance, in which state it may be preserved for any length of time. In the fluid state, extended on paper or on glass, diluted or not with water, mixed with the sensitive iodide of silver, it is employed as a medium whereon to make photographic pictures — either negatives or positives: to the latter it imparts great brilliancy.

By the Continental photographers albumen is much more employed than collodion; as in a warm temperature it has not the inconvenience of evaporating too quickly, and becoming unmanageable, like the etherial solution of xyloïodine.

Positives on albumenized paper possess greater brilliancy, with much more detail than those taken upon paper not so prepared (80).

(120.) Alcohol. (C^4 H^6 O^2)

This well-known liquid is of various applications in photography; it is added to Ether to make the solution of gun-cotton or paper, and to various sensitive preparations, for which purposes it must be free from acid or other impurity; it is frequently reduced in strength by the addition (fraudulent) of water, from which it may be freed by digestion with dry carbonate of potash, or by re-distillation.

(121.) Ammonia Solution.

(Ammoniacal gas being $N H^3$
its Equivalent, $17 = N\ 14 + H\ 3 + x\,H\,O$)

Water dissolves about 700 times its volume of ammonia (ammoniacal gas). It is a very powerful reagent, and must be employed in photography with great caution, as it forms highly-explosive compounds with silver, iodine, and chlorine. Ammonia completely dissolves chloride of silver: when it is cautiously added to a solution of nitrate of silver, at first a brown precipitate falls, which is an oxide of

silver; by carefully adding more ammonia, drop by drop, this powder is redissolved. The clear solution (ammonio-nitrate of silver) was first suggested by Dr. Alfred S. Taylor, as a wash for positive paper, and I prefer it to every other preparation of silver for positives (79). The paper, previously prepared with the muriate of ammonia wash, is to be carefully wetted with this solution, and dried. If any of the ammonio-nitrate dries round the stopper of the bottle in which it is kept, it may explode violently by friction; it is better, therefore, to keep none prepared, but to make as much as is required for use at one time.

A very weak solution of ammonia may be used as a "fixing" agent for those proofs which have been taken with nitrate of silver, or the ammonio-nitrate. It is also added to the nitrate-of-silver bath to correct the presence of free acid (102).

(122.) Bromide of Ammonium. (NH^4Br)

(Equivalent, 98 = N 14 + H 4 + Br 80)

A solution of this salt in its weight of water has been recommended for "fixing" negative proofs. It is only necessary to leave them for a quarter or half-hour in a bath of this solution, and afterwards

wash them in several waters, when they will be completely fixed.

This salt can also be used in the preparation of sensitive paper, both for negatives and positives. M. Le Gray's formula is—

Distilled water . .	1000 parts.
Iodide of potassium .	15 „
Bromide of ammonium .	4 „
Sugar of milk . .	40 „

It is employed by many photographers under the impression that the green foliage of landscapes is better represented in the proofs. It is also added to Collodion.

(123.) Bromide of Potassium. (K Br)

(Equivalent, 119 = K 39 + Br 80)

Bromide of potassium serves to form bromide of silver, by decomposing the nitrate; the resulting bromide is more sensitive to certain colours of the spectrum than the iodide. It is insoluble in water and in alcohol, but dissolves in solutions of ammonia and hyposulphite of soda. It is used by M. Le Gray and others in combination with chloride of

sodium in the preparation of sensitive paper. The formula given is—

Distilled water .	.	10 drachms.
Bromide of potassium	. 1	„
Chloride of sodium .	. 1	„

Paper washed with this preparation is placed upon the aceto-nitrate of silver, as indicated in other preparations, and afterwards proceeded with in the same manner. There appear to be some difficulties attending its employment. We must content ourselves, therefore, with merely indicating its use.

(124.) Bromide of Silver. (Ag Br)

(Equivalent, 188 = Ag 108 + Br 80)

Bromide of silver is obtained by decomposing nitrate of silver by bromide of potassium. In combination with nitrate of silver it is one of the most sensitive preparations used in photography yet discovered. It requires to be employed in a very diluted state to effect the greatest change, and should be applied to the paper in the following manner:

Wash the paper with the following solution:—

Bromide of potassium . .	40 grains
Chloride of sodium . .	40 „
Distilled water . . .	1 ounce

The addition of the chloride of sodium increases the sensitiveness. When dry, float the paper upon a solution of nitrate of silver, forty grains to the ounce of water; dry the paper quickly, without scorching, and then apply another wash of the solution of nitrate of silver. The addition of a drachm of alcohol to the nitrate of silver gives a deeper black tint to the proofs.

It is said that bromide of silver is modified by certain colours which do not affect the iodide.

(125.) Camphor,

Dissolved in water, is employed in photography to diminish the tendency to spontaneous decomposition in the gallic acid solution used for developing negatives on waxed paper.

(126.) Caustic Potassa. (K O, H O)

(Equivalent, 56 = K 39 + H 1 + O 16)

This alkali, when added to a solution of nitrate of silver, precipitates the metal in the state of an oxide. A small quantity dissolved in water is used to give a variety to the tones of the proofs after they have been submitted to the action of hyposulphite of soda. It acts with great energy, and the proof must, therefore, be carefully watched, and plunged into clean water as soon as the desired effect is produced.

(127.) Chloride of Ammonium, or Hydrochlorate of Ammonia, Muriate of Ammonia, Sal Ammoniac. ($N H^4$, Cl)

(Equivalent, 54 = N 14 + H 4 + Cl 36)

Hydrochlorate of ammonia is very useful in the preparation of positive paper; it decomposes nitrate of silver, forming the chloride of that metal, and is a better preparation than chloride of sodium. 100 parts of cold water dissolve 36 parts of the salt, and boiling water its own weight; and it is also very soluble in alcohol.

(128.) Chloride of Barium. (Ba Cl, 2 H O Muriate of Barytes)

(Equivalent, 122 = Cl 36 + Ba 68 + H 2 + O 16)

Paper for positives prepared with this salt in the same manner as when chloride of sodium or hydrochlorate of ammonia is employed to decompose the nitrate of silver, yield very good brown tones. When the proof has been exposed to the light a sufficient length of time, it is washed in water containing ten per cent of protosulphate of iron, which yields upon the paper a white insoluble precipitate of pleasing effect. After it has remained about five minutes in the bath, it is washed, and the "fixing" continued with hyposulphite of soda, as with the other preparations. Chloride of barium is soluble in cold water, 100 grains dissolving about 43 grains of the salt at a temperature of 60°, and 78 grains at 223°, which is the boiling point of the saturated solution.

The soluble salts of barium are poisonous.

(129.) Ter-Chloride of Gold. ($Au^2 Cl^3$)

(Equivalent, 308 = Au 200 + Cl^3 108)

Chloride of gold is prepared by dissolving one part of gold, in a state of fine powder, in three parts

of nitro-hydrochloric acid (*aqua regia*). It is soluble in water, alcohol, and ether, and easily reduced by heat. In combination with hyposulphite of soda, it yields the *sel d'or*, in a bath of which the positive proofs may be placed after they are fixed by hyposulphite of soda: it gives to the picture a very rich, deep violet black tone (86).

It is also useful to develope faint collodion negatives, imparting to them increased density, and a remarkable black tint in the lights. It must be applied after the negatives have been fixed by hyposulphite of soda, and absolutely freed by washing from any trace thereof, by pouring upon them the following solution:—

Ter-chloride of gold . .	15 grains.
Chloride of ammonium . .	10 grains.
Distilled water . . .	1 pint.

(130.) Chloride of Mercury. (Hg Cl)

(Equivalent, 136 = Hg 100 + Cl 36)

The chloride of mercury, commonly called the *bi*-chloride, or corrosive sublimate, is employed in

photography for converting collodion negatives, particularly collodion, into positives.

Saturate muriatic acid with chloride of mercury; add one part of the solution to six parts of water; after the proof is fixed and washed, pour a small quantity over it from one corner, and allow it to run evenly over the proof. A peculiar whitening appears in a few seconds, and a singularly delicate picture is produced. After being washed and dried, it can be varnished and kept as a positive; but, what is most singular, even after this bleaching, it can be reconverted into a negative of much greater strength than it was originally, by washing it with a weak solution of hyposulphite of soda, or of ammonia: the white picture vanishes, and a black negative reappears.

When the mercury is first applied to the negative it deepens its shades, and greatly strengthens the face of the proof, and the process of change can be stopped at this point by simply immersing the plate in water. When this result is desired the solution should be used much more diluted with water than when it is required for converting negatives into positives. This conversion can be repeated several times, often to the great improvement of the proof.

(131.) Chloride of Silver. (Ag Cl)

(Equivalent, 144 = Ag 108 + Cl 36)

This salt is rapidly acted upon by light, hence it has been extensively used in photography: it is readily obtained whenever we mix a soluble chloride with a soluble salt of silver; as, for instance, chloride of sodium with nitrate of silver. When paper is washed with a solution of chloride of sodium, and afterwards with nitrate of silver, the latter salt is decomposed and converted into chloride of silver.

A coating of chloride of silver can also be obtained by the combination of hydrochloric acid, hydrochlorate of ammonia, or chloride of strontium, and of most other chlorides with the nitrate of silver. The results are nearly the same, and the coating of chloride of silver is equally sensitive. Upon the whole hydrochlorate of ammonia will be found preferable.

Chloride of silver is insoluble in water and in weak nitric acid. Diluted hydrochloric acid and chlorides dissolve it to some extent. The alkaline cyanides, solutions of ammonia and of hyposulphite of soda, are the most useful solvents, and they therefore serve to "fix" the positive images.

Chloride of silver darkens rapidly under the

influence of light, and is even more sensitive than the iodide of silver; but it cannot be used alone for negatives, for the effect of the gallic acid is to blacken it all over. Were it not for this defect, it would supply an excellent negative paper for the camera.

But, on the other hand, chloride of silver is of the greatest value for obtaining positive proofs without the aid of a reagent to develope the image. Those portions acted upon by light are rapidly brought to a state approximating to the metallic condition, and if the exposure is prolonged, the silver is entirely reduced.

To arrest the action of light, it is sufficient to remove those portions of the salts of silver unchanged by the light from the surface of the paper, which is effected by the before-mentioned fixing agents.

(132.) Chloride of Sodium. (Na Cl)

(Equivalent, 60 = Cl 37 + Na 23)

Chloride of sodium is known as Muriate of Soda, or more familiarly as common culinary salt.

It is obtained in greater purity by saturating carbonate of soda with hydrochloric acid. In photography it is used to prepare the positive paper, upon which a coating of chloride of silver is produced by decomposing the nitrate of silver with a chloride.

Mixed with a small quantity of iodide and of bromide of potassium, the chloride of sodium supplies us with an excellent preliminary wash for the negative paper.

(133.) Chloride of Strontium. ($Sr\,Cl, {}^{6}H\,O$)

(Equivalent, 134 = Sr 44 + Cl 36 + H 6 + O 48)

The use of this salt can only be allowed when no other chloride is at hand to decompose the nitrate of silver, as it attracts much moisture from the air. 100 grains of cold water dissolve 50 grains, and boiling water much more, of this salt.

(134.) Soluble Gun-Cotton, or Paper. (Xyloïodine.*)

One of the best processes for making this is the following:—

Sulphuric acid, sp. g. 1·840 . .	20 fluid ounces.
Pure nitrate of potash in powder	13 ounces.
Best carded cotton	5 drachms.

Mix the acid and nitre in a Wedgwood mortar, and stir them together for half a minute, then quickly immerse the cotton, and with the pestle cause the liquid to thoroughly penetrate the mass. Cover it up with a piece of glass, and let it rest 10 or 12 minutes. Then turn it out into a *large quantity of water, and cause it to distribute itself quickly therein.* Wash it in water, frequently changed, until no trace of acid is perceptible; finally dry it by extending it loosely over bibulous paper.

For many reasons the following is the better material:—

Nitric acid, sp. g. 1·425 . .	7 fluid ounces.
Sulphuric acid, sp. g. 1·840 .	8 fluid ounces.
Swedish filtering paper . .	1 ounce, more or less, cut in pieces.

Mix the acids in a Wedgwood mortar, cut the

* This and 135, 136, communicated by Mr. J. B. Hockin.

paper into small strips and *immerse* them one by one—cover up as before; within half an hour take out *a small piece from the middle*, quickly wash and dry it, and try its solubility in alcoholized ether (*vide infra*). If not sufficiently soluble, let it remain ten minutes longer, and again try its solubility. If satisfactory, turn it out into a large quantity of water, and treat in the manner before described for the cotton.

Great care must be exercised not to *over-do* these products, as the result would be that the collodion, instead of producing a perfectly transparent film, would exhibit an opaque papyraceous mass.

In preparing this substance great caution must be taken to avoid inhaling the nitrous acid fumes given forth when the sulphuric acid is added to the nitre. It must also be remembered that gun-cotton is a highly-explosive compound, and that when dry it will ignite spontaneously if kept in too warm a place.

(135.) Collodion.

Soluble paper, or cotton . .	4 grains.
Alcohol 60 over proof . . .	3 drachms.
Pure ether, free from water . .	5 drachms.

Mix these together until entirely dissolved, and leave in a cool place to settle for some days; pour off the clear liquid, and preserve for use.

It is necessary to observe in this place that the alcohol must be of the strength specified, and that the ether be free from mixture with water and alcohol. If, however, it contains the latter, the quantity must be ascertained, and subtracted from the quantity prescribed in the above formula. The following is a sufficiently accurate method of ascertaining the quantity of alcohol present in a specimen of commercial ether.

Procure a two-ounce phial as nearly cylindrical as possible, paste a strip of white paper on it from top to bottom, and measure into it $1\frac{1}{2}$ drachms of water; mark the level of the liquid on the paper, and so proceed until 10 measures (15 drachms) have been added; then put in 5 measures of the ether to be examined, and 5 of distilled water, shake them well up, and allow the mixture to repose: the number of measures occupied by the supernatant liquid (ether) multiplied by 10, will give the per-centage of pure ether contained in the sample.

It is of the greatest importance that the ether be free from water; if contaminated therewith it must be shaken with dry carbonate of potash (2 oz.

to the pint) for an hour, and after reposing twelve hours, poured off clear.

Good collodion possesses the following qualities:—

Perfect limpidity.—It must be carefully noted that substances floating in the collodion cause spots or specks upon the films, which will produce so many blemishes in the positives, and frequently render them useless.

Fluidity, of such a degree as to flow quickly and evenly over the surface of the glass plate, leaving an extremely thin tenacious film, free from streaks (*striæ*) or reticulations.

It should also be almost entirely *free from colour*, and be capable of retaining this property for at least several weeks; otherwise, the coloration being due to the liberation of free iodine, the collodion becomes much less sensitive than when almost colourless.

As some portion of the ether evaporates every time the stopper is removed from the bottle in which this solution is kept, it is preferable to have a small bottle containing only as much as is required to take a few pictures on, and replenish it from the larger stock-bottle as required. If it becomes too thick it can be diluted with more ether.

(136.) Iodized Collodion.

Take of

Alcohol, 60° over-proof . .	5 ounces.
Carbonate of ammonia . .	12 grains.

Mix well in a mortar, and pour into a bottle to settle.

Take of the

Clear liquid	4 drachms.
Iodide of ammonium . .	20 grains.
Iodide of silver . . .	5 grains.

Mix well, and left to settle.

The same clear liquid . .	4 drachms.
Iodide of ammonium . .	20 grains.

Mix and allow to settle.

Filter off equal quantities of these two solutions, add them together, and preserve for use, labelling the compound *iodizing liquid*,

To iodize the collodion, mix

Collodion (as above) . .	7½ drachms.
Iodizing liquid . . .	½ drachm.

The collodion should be iodized at least twelve hours before it is required for use, and be poured off clear from the very slight deposit which results from mixing. The resulting iodized collodion is a highly sensitive preparation, and keeps well.

The nitrate-of-silver bath may be used perfectly neutral, but acts more efficaciously if it exhibits the feebly acid reaction described (102).

(137.) Cyanide of Potassium. (K C y)

(Equivalent, 79 = K 39 + C 12 + N 28.)

This salt may be considered as a compound of prussic acid with potash; it is a very deadly poison. It is used in photography; added to nitrate of silver, it yields cyanide of silver, which is very sensitive to the action of light; but when added to the iodide and the fluoride, it is said to form a triple salt of great sensitiveness. Cyanide of silver is insoluble in water, and in diluted nitric acid. It is decomposed by hydrochloric acid, and changed into chloride of silver. Solution of ammonia, the alkaline cyanides, and especially hyposulphite of soda, dissolve it.

Cyanide of potassium dissolves iodide, chloride, and bromide of silver; it also dissolves the oxide of this metal when it is precipitated by gallic acid. A solution of the salt applied with a brush is useful to remove the black spots which injure the proofs; only it must be applied with great caution, and the proof immersed in water immediately after its application, else it may destroy it entirely. It is the best fixing agent for collodion pictures, both positive and negative.

The cyanide of potassium is useful for removing the stains of nitrate of silver from the hands. In using it great caution must be observed that the skin is not wounded, else it might occasion considerable irritation.

(138.) Ether. ($C^4 H^5 O$)

Sulphuric ether is colourless, volatile fragrant liquid, very combustible, slightly soluble in water, and miscible with alcohol in all proportions. In photography its chief use, when mixed with alcohol, is as a solvent for gun-cotton to produce collodion *q. v.*

(139.) Fluoride of Ammonium. ($N H^4 Fl$)

(Equivalent, 37 = Fl 19 + N 14 + H 4)

This salt, added to iodide of potassium, imparts a great increase of sensitiveness.

(140.) Fluoride of Potassium. (K Fl)

(Equivalent, 58 = Fl 19 + K 39)

Fluoride of potassium adds to the sensitiveness of the prepared paper when mixed with iodide of potassium. The process in which the fluorides are employed is termed the Fluorotype.

(141.) Formic Acid. ($C^2 H^2 O^4 + H O$)

Formic acid is obtained by submitting certain organic substances to oxidizing agents, in heating a mixture of diluted sulphuric acid and peroxide of manganese with alcohol, sugar, starch, tartaric acid, grain, &c. One portion of the organic body undergoes a complete *combustion* and yields water and carbonic acid; the other is imperfectly oxidized, yielding formic acid. It is prepared by mixing—

1 part sulphuric acid, sp. gr. 1·845.
1 part water.
1 part bruised grain.

Heat them together in a very capacious retort until the mass becomes thoroughly black. One part of boiling water is then cautiously added, and when thoroughly mixed the compound is distilled until one measure has passed over; another part of water is then added, and again a measure distilled; this generally contains some sulphurous acid, which is easily removed by the addition of peroxide of lead and redistillation. It is also contaminated with *furfurol*, which however does not appear to be injurious in its applications to photography.

Formic acid has been recommended by Mr. Maxwell Lyte as a useful adjunct to the developments of positive pictures on glass; and it also appears to possess some blackening properties when

used in the same proportions as acetic acid in the pyrogallic solution for negatives. Sufficient attention, however, has not yet been given to it. The energetic reducing properties of formiate of ammonia may at some time recommend it to the chemical photographer.

(142.) Gallic Acid. ($C^7 H^3 O^5$ 2 H O)

(Equivalent, 103 = C 42 + H 5 + O 56)

This acid is obtained from nut-galls. It is employed in photography on paper as a developing agent for negative proofs, giving to them black tones.

All the salts of silver generally, which are near the metallic state, are precipitated of a black-brown colour by this acid: consequently we can employ it for developing the proofs made by iodide, bromide, fluoride, or cyanide of silver.

Some practitioners recommend that this salt be used in a concentrated state, as a rapid developing agent. M. Le Gray uses a weak solution, fifteen to thirty grains to a quart of distilled water, from which, it is his opinion, there is much less danger of

spotting the proofs: it takes more time to develope them, which is compensated for by their greater beauty.

Gallic acid is but slightly soluble in cold water, 1 grain of the acid requiring 100 grains of water for its solution; but 3 grains of boiling water will dissolve 1 grain of the acid. The solution is gradually decomposed by keeping.

When the proof is almost entirely developed, if we add a little aceto-nitrate of silver the shadows become immediately more intense; but it must be carefully watched, else this intensity will become too great from too rapid a precipitation.

(143.) Grape-Sugar. (Glucose.)* $C_{12}H_{14}O_{14}$

Glucose is met with in commerce under three different forms: syrup of starch, granulated, and in mass. As it is likely to play a very important part in photography, and as it is sometimes difficult to procure, it may be desirable to state the process of its manufacture.

It is obtained by boiling a thin paste of starch

* Communicated by Mr. J. B. Hockin.

with four to eight per cent of sulphuric or of oxalic acid for twelve to fifteen hours, renewing the water as it evaporates, and continuing the operation until the produce is no longer rendered blue by the addition of solution of iodine.

The acid is then precipitated by the addition of chalk, and the liquid filtered from the residue, evaporated at 212° until a small portion placed on a cold surface speedily *sets*.

Grape-sugar has been employed by Mr. Maxwell Lyte with great success for increasing the sensitiveness of excited collodion plates, and causing them to keep in good condition for the camera during some few hours.

He proceeds as follows. Take—

Grape sugar	8 ounces.
Distilled water	6 „
Alcohol	1 „

Mix and filter.

Nitrate of silver	200 grains.
Distilled water	6 ounces.
Iodide of silver	10 grains.

Agitate these for some time, and filter before using.

On mixing equal volumes of these, the mixture becomes turbid; they should be exposed *only to diffused daylight*, and, when nearly clear, filtered.

The collodion plate excited in the ordinary manner is to be placed on the level-stand, and the liquid poured over the surface; if, from the

difference of density existing between it and the nitrate bath, it does not mix readily, it must be poured off into a measure, and poured on again once or twice; after five minutes the plate may be drained, and placed on the slide for use.

Glucose, from its energetic reducing properties and miscibility without decomposition with nitrate of silver, merits attention at the hands of every chemical photographer.

(144.) Hydrochloric Acid. (H Cl, Muriatic Acid)

(Equivalent, 37 = Cl 36 + H 1)

This acid is prepared by decomposing common salt with sulphuric acid. Diluted with water it has been employed to give a rich brown tone to the proofs after they have passed through the bath of hyposulphite of soda, and been washed in water. Mixed with nitric acid it forms the aqua regia in which gold is soluble, and from which *sel d'or*, or hyposulphite of gold and soda, is obtained.

(145.) Hypochlorite of Potassa. (K O, Cl O)

This salt has bleaching properties, similar to those of chloride of lime. Dissolved in its weight of water, the solution is applied to spots or stains on the prepared paper. It also fixes the positive proofs, and yields very agreeable tones. The hypochlorite of lime (bleaching powder) produces the same effect.

(146.) Hyposulphite of Soda.
(Na O, S^2 O^2 + 12 H O)

(Equivalent, 187 = Na 23 + S 32 + O 120 + H 12)

This salt was discovered by Sir John Herschel in 1819; it is very soluble in water at all temperatures, and much used in photography for "fixing" the proofs, which it accomplishes by dissolving the salts of silver, such as the chloride, iodide, &c., which are insoluble in water, and so removing them from the proof, and thereby preventing any further chemical change in the impression. The solution of hyposulphite of soda, after it retains some of the salts of silver in solution, is more useful for the fixing process, as it gives better

black tones than when first employed. It is the best fixing material yet discovered except cyanide of potassium, both for positives and negatives; and by careful manipulation almost every variety of tone can be given to the proofs. With faint positive proofs it is best to soak them for a few minutes in a bath of clean water in the dark room, before submitting them to the action of the hyposulphite of soda; by which means the soluble salts of silver are removed without affecting those parts acted upon by the light, which constitute the blacks.

Thus we abridge the time necessary for the action of the hyposulphite, and the fixed image is found to be more vigorous than if it had been placed at once in the hyposulphite of soda.

(147.) Iodine

Is sometimes added to the iodizing solution for waxed Canson's paper: it combines with the starch contained therein, colouring it a deep purple, and most probably tends to preserve the clearness of the shadows by means of the small amount of nitric acid eliminated by it during *the exciting* of the paper in the silver solutions.

(148.) Iodide of Ammonium. ($N H^3$, H I) (Hydriodate of Ammonia.)

(Equivalent, 145 = N 14. H 4. I 127)

The hydriodate of ammonia is a compound very easily decomposed: it must be kept suspended in a bottle containing a small quantity of carbonate of ammonia.

Sensitive papers may be prepared by washing them with a solution of this substance previous to placing them upon the aceto-nitrate of silver; an impression is received with great rapidity, which is developed with facility by gallic acid, to which a little acetate of ammonia has been added.

Paper prepared with the hydriodate of ammonia will not keep long; it loses its sensitiveness by the continuous evaporation of the ammonia.

(149.) Iodide of Potassium. (K I) (Hydriodate of Potash.)

(Equivalent, 166 = K 39 + I 127)

Iodide of potassium is one of the principal chemical agents in photography. It serves to form

iodide of silver, by decomposing the nitrate. This iodide of silver is insoluble in water, but soluble in hyposulphite of soda, which is used for "fixing" the negative proofs.

100 parts of water at 65° will dissolve 143 parts of iodide of potassium.

(150.) Iodide of Silver. (Ag I)

(Equivalent, 235 = Ag 108 + I 127)

Iodide of silver is obtained by adding iodide of potassium in solution to a solution of nitrate of silver; decomposition ensues, the nitric acid leaves the silver and unites with the potash, while the liberated iodine combines with the silver, and falls as a yellow precipitate, which must be well washed in distilled water, being insoluble therein, to remove the nitrate of potash, and then dissolved in a saturated solution of iodide of potassium. This mixture is to be added to the collodion in small quantities at a time, and agitated until dissolved.

Formula for the preparation of iodide of silver:

Distilled water . . .	1 ounce
Nitrate of silver . . .	30 grains.

Add to it as much of an aqueous solution of iodide of potassium as will precipitate the whole of the nitrate of silver as an iodide. When this precipitated iodide of silver has settled, the fluid must be decanted, and fresh water added several times, to wash out all the nitrate of potash. Drain off all the water, and when dry cover the iodide with sufficient alcohol to keep it moist. This iodide of silver is soluble in iodide of potassium: the quantity required to iodize the collodion cannot be stated with certainty; about twenty-five to thirty drops to the ounce is usually added (136).

Pure iodide of silver is slowly changed in colour by exposure to light, but in conjunction with nitrate of silver and with gallic acid it acquires an extraordinary degree of sensitiveness.

(151.) Nitrate of Baryta. ($Ba\,O, N\,O^5$)

(Equivalent, 130·5 = Ba 68·5 + N 14 + O 48)

This salt is prepared by dissolving carbonate of baryta in nitric acid. It is used in photography to obtain the proto-nitrate of iron, by decomposing with it a solution of proto-sulphate of iron.

(152.) Nitrate of Magnesia. ($Mg\,O, N\,O^5$)

Equivalent, 74 = Mg 12 + N 14 + 48.

Nitrate of magnesia is recommended by Messrs. Spiller and Crookes as a deliquescent salt, adapted for preserving the sensitiveness of collodion plates, by keeping them moist during out-of-door operations, while conveying the plate between the darkened room and the camera, or for a longer time if required. The process is as follows:—

The plate coated with collodion in the usual manner is rendered sensitive in the nitrate-of-silver bath, in which it should be allowed to remain *five* minutes; it must then be slightly drained and immersed in a second bath, consisting of

Nitrate of magnesia . . .	4 ounces.
Nitrate of silver . . .	12 grains.
Glacial acetic acid . . .	1 drachm.
Water	12 ounces.

And there left for about five minutes, then removed and placed in a vertical position on blotting-paper until all the surface moisture is drained off and absorbed; this generally takes place in about half an hour,—the plate may then be put away in a convenient box until required for use.

Before developing it will be found advisable to moisten the collodion film by immersion in the nitrate-of-silver bath for about half a minute, else

the pyrogallic acid or iron solution will not flow evenly over the plate. The "fixing" operation is conducted as usual. It is necessary to success that the nitrate of magnesia be quite pure.

(153.) Nitrate of Potash. ($K O, N O^5$)
(Nitre. Salt Petre.)

(Equivalent, 101 = K 39 + N 14 + O 48)

This salt should be used in crystals, and purified: the ordinary nitre of commerce is contaminated with chloride of potassium. Nitrate of potash is employed in photography as a means of obtaining proto-nitrate of iron by decomposing proto-sulphate of iron (153).

(154.) Nitrate of Protoxide of Iron.
($Fe O, N O^5$)

(Equivalent, 90 = Fe 28 + N 14 + O 45)

A solution of this salt is employed for developing collodion proofs as negatives, either alone or in combination with pyrogallic acid. It is best pre-

pared by decomposing a solution of an alkaline nitrate by a solution of the sulphate of protoxide of iron in the following manner:—Make a solution in 6 ounces of hot water of 300 grains of nitrate of baryta; when dissolved, add 320 grains of sulphate of protoxide of iron, dissolved in 6 ounces of water, and stir the mixture with a glass rod. After a while the sulphate of barytes formed by the decomposition falls to the bottom of the vessel, and the supernatant liquid, the proto-nitrate of iron, may be decanted, and kept in a well-stoppered bottle for use. This solution is very liable to decomposition; so long as it retains an emerald green colour it is fit for use, but if it turns red it should be thrown away (107).

(155.) Nitrate of Silver. ($Ag\,O, N\,O^5$)

(Equivalent, 170 = Ag 108 + N 14 + O 48)

Nitrate of silver is a very important ingredient in photography; it is a compound of nitric acid with the oxide of silver. It is decomposed by iodide of potassium, by which iodide of silver is obtained. The best nitrate of silver is in thin colourless crystalline plates (the *fused* is generally

adulterated), which are soluble in an equal weight of cold water. Exposed to light this salt blackens if any organic matter is present; advantage is taken of this property to prepare the sensitive solutions which are spread upon paper and other media employed in obtaining photographic pictures. It is readily decomposed by chlorides, bromides, fluorides, cyanides, &c., producing salts of exquisite sensibility; the silver is partially *reduced*, primarily by the action of light, and eventually brought to the metallic state in a more or less finely divided condition by the developing (reducing) agents, gallic acid, pyrogallic acid, and the proto-salts of iron, &c. The chief object and aim in the future of photography is in the direction of the developing agents. We have found substances which require but an instantaneous exposure to the action of light to effect that change, which once set up is continued and completed by suitable developing agencies.

(156.) Nitrate of Zinc. ($Zn\,O, N\,O^5$)

(Equivalent, 94 = Zn 32 + N 14 + O 48)

Nitrate of zinc is obtained by dissolving granulated zinc in diluted nitric acid. M. Le Gray uses

it to give body to thin paper, by washing it with a solution of 6 parts of nitrate of zinc in 100 parts of water, drying it, and then immersing it in the bath of iodide of potassium. The precipitate, falling upon the surface of the paper, closes the pores, and it is insoluble in water. Lately nitrate of zinc, on account of its deliquescent quality, has been recommended for prolonging the sensitiveness of collodion on glass. Mr. Crookes, who first employed it, recommended that it should be dissolved in a small quantity of water, and the liquid poured over the sensitive collodion plate: he now gives the preference to nitrate of magnesia (152). We have no great faith in either of these agents; the presence of a large quantity of foreign matter cannot but be prejudicial to the sensitive compound.

(157.) Nitric Acid. ($N O^5$, H O)

(Equivalent, 63 = N 14 + H 1, O 48)

This acid is obtained by distilling a mixture of equal parts by weight, of nitrate of potash and sulphuric acid. It is very abundant in commerce, and is useful in photography to form nitrate of silver; and in combination with hydrochloric acid (*aqua*

regia) to yield the CHLORIDE OF GOLD; added to the sulphate of the protoxide of iron, it converts it on boiling into the sulphate of the peroxide.

It is also employed to darken the tone of the shadows of the positive proofs after they have been submitted to the action of hyposulphite of soda. Its action is similar to that of muriatic acid used for the same purpose.

As it possesses great solvent powers for silver, it is very useful for removing the deposit left on the gutta percha or porcelain dishes, &c.; but the greatest care must be taken that no great excess of free acid appear in any of the preparations used in photography; for however useful in its combinations with silver, &c. alone, it has a most destructive influence by its neutralising the effects produced by the agency of light.

(158.) PYROGALLIC ACID. ($C^6\ H^3\ O^3$)

(Equivalent, 63 = C 36 + H 3 + O 24)

This powerful developing agent is prepared, according to the formula of Dr. Stenhouse, in the following manner:—

Make a strong aqueous infusion of powdered nut-galls; pour it off from the undissolved residue,

and carefully evaporate to dryness by a gentle heat: towards the conclusion of the process the extract is very liable to burn; this is best prevented by continually stirring with a glass or porcelain spatula. Next, procure a flat-bottomed iron pan, about ten inches in diameter, and five inches deep. Make a hat of cartridge-paper about seven inches high, to slip over and accurately fit the top of the iron pan. Strew the bottom of the pan with the gall extract to the depth of three-quarters of an inch; over the top stretch and tie a piece of bibulous paper, pierced with numerous pin-holes; over this place the hat, and tie it also tightly round the top of the pan.

The whole apparatus is now to be placed in a sand-bath, and heat cautiously applied. It is convenient to place a thermometer in the sand-bath as near the iron pan as possible. The heat is to be continued about an hour, and to be kept between 380° and 400° F.: on no account to exceed 420°. The vapour of the acid condenses in the hat, and the crystals are prevented from falling back into the pan by the bibulous paper diaphragm. When it is supposed that the whole of the acid is sublimed, the strings are to be untied, and the hat and diaphragm cautiously taken off together; the crystals will be found in considerable quantity, and may be removed into a stoppered bottle: they should be very brilliant, and perfectly white; if there is any yellow tinge, the heat has been too great.

Pyrogallic acid dissolves readily in water; the solution is speedily decomposed, becoming black.

It is perhaps more economically procured from rough commercial gallic acid, mixed with equal quantities of sand, and distilled as before directed.

(159.) Sugar of Milk.

Sugar of milk is produced to a large extent in Switzerland by evaporating the whey obtained in the manufacture of cheese. It is added to the iodizing solution for paper, under the impression that the sensitiveness is increased thereby.

(160.) Sulphate of Protoxide of Iron. ($Fe\,O, S\,O^3$)

(Equivalent, 76 = Fe 28 + 4 O 32 + S 16)

This substance is well known under the names of green copperas and green vitriol. It is employed

in photography as a developing agent, principally for positives, but many photographers experience great success in developing negatives therewith, replacing the acetic acid by tartaric acid.

(161.) Tartaric Acid. ($C^4 H^2 O^5 + H O$)

(Equivalent, 75 = C 24 + H 3 + O 48)

Tartaric acid is used in conjunction with protosulphate of iron to form a developing agent for negatives (160). Some photographers have met with great success in employing it as a substitute for acetic acid. Tartrate of silver grows darker under the influence of light than any other salt of silver, which recommends it for use in positive pictures. Its want of sensitiveness precludes its use for negatives.

Xyloïdine.

See Gun-Cotton (134).

"SIZING" MATERIALS.

Starch, Albumen, Gelatine, Wax.

(162.) Starch dissolved in boiling water forms a "size," which is afterwards insoluble in cold water; the best for the purposes of photography is obtained from rice (p. 35).

Starch has a great affinity for iodine, which it colours of a deep blue, and serves to aid us in recognising its presence in a liquid. Wax has also a similar affinity for iodine.

(163.) Dextrine.—Starch is capable of being converted into a gummy substance called dextrine. A mixture of 15 parts of starch, 60 parts water, and 6 parts sulphuric acid, may be kept boiling for about four hours; the liquid neutralised with chalk, filtered and rapidly evaporated to a small bulk. This substance is dextrine, and is sold under the name of British gum. It is a useful substitute for glue, as it is soluble in cold water.

(164.) A warm solution of Gelatine, applied upon paper at the same time with the iodide and other salts, leaves a size which does not readily dissolve in cold water.

(165.) Albumen also forms an excellent size, from its property of becoming insoluble by the application of heat above 180°.

(166.) Collodion applied to paper answers the purpose of a size; but its chief application is to glass, when iodized, to obtain instantaneous impressions.

This substance has a remarkable effect in forming the blacks in the proofs, at the same time it is a good size.

(167.) Wax becomes permeable to liquids after it has remained in a bath containing alkaline salts; it forms also an excellent size, and does not exclude the use of other sizing materials.

(168.) Alum.—English paper soaked for a few minutes in a strong solution of alum, and afterwards washed in clean water, is in an improved condition for receiving the solution of salts of silver for positives.

VARNISHES.

(169.) VARNISH FOR NEGATIVES.

All photographic pictures should be varnished. The collodion surface is so exceedingly delicate that the least friction injures it. A good temporary varnish for a negative, from which only one or two positives are required, will be found in strong gum-water.

For a permanent varnish nothing is found equal to the amber varnish, prepared as follows:—Digest for several days one ounce of amber, broken in small pieces, in one ounce by weight of chloroform, and filter in a close apparatus. When this is poured over the plate in the same manner as directed for the collodion, and drained off, it dries instantly.

The varnishes next best in quality are the colourless spirit-laquers. For these the proof must be warmed, and before the varnish ceases to drip the plate must be strongly heated.

(170.) VARNISH FOR POSITIVES.

A black varnish, called patent jet, and other names, is used for backing positives. It must not be applied until the collodion surface is defended by a coating of gum, or by the amber varnish mentioned above, since its slow drying properties, and the want of solubility of the colouring matter, cause the fluid portion to penetrate the collodion film, and mask the finer details of the proof. For positives on paper, albumen and gelatine are used.

DEFINITION

OF THE

TECHNICAL TERMS EMPLOYED IN PHOTOGRAPHY.

Concentration.—This is a thickening process produced by the action of heat upon solutions, by which the liquid is evaporated, and the solution becomes more dense, or nearer to the solid state.

Crystallization.—Certain bodies, such as salts, in passing from a state of solution to the solid, assume regular forms which are called crystals. By re-dissolving these crystals, and again crystallizing them, we obtain the crystallized substances in a state of greater purity.

Decantation.—Solutions, when allowed to stand undisturbed for a certain time, frequently deposit a sediment, from which it is desirable to remove the clear supernatant liquid; this operation, when ac-

complished by a siphon or pipette, or by gently inclining the vessel so as not to disturb the sediment, is termed Decantation. It sometimes precludes the necessity for Filtration.

Decomposition.—This action takes place when two compound solutions are mixed, and the constituents change places; for instance, when we add sulphuric acid to chloride of barium, the acid seizes upon the barium forming sulphate of barytes, and the chloride is displaced or set free; but when we add nitrate of silver to chloride of barium, *double* decomposition ensues; the chlorine goes to the silver, giving rise to chloride of silver, while the nitric acid combines with the barium, forming nitrate of barytes.

Diaphragm.—Discs pierced in their centre with round holes of different dimensions, and placed in front of the lenses of the camera, to exclude the excess of light, and to modify the clearness of the image in the focus. They also serve to correct the spherical aberration.

Evaporation.—Certain volatile substances, such as ether, alcohol, &c., evaporate upon exposure to the atmosphere; so also does water, and other fluids, but more slowly: when these fluids contain solid bodies in solution, by evaporation they become concentrated, and finally restore to the solid form the solid held in solution, which is left behind by the removal of the fluid in the state of vapour.

PROOFS, POSITIVES AND NEGATIVES.—The impressions produced by the action of light upon prepared sensitive media are of two kinds, NEGATIVES and POSITIVES. The NEGATIVES are those in which the lights and shadows are reversed, such as are obtained in the camera on paper, albumen, &c. The *Negatives* obtained upon collodion can be converted into *Positives* by varying the developing process.

POSITIVES are those obtained by super-imposing a Negative upon paper prepared for the purpose; producing a reverse effect by the passage of light through the non-darkened portions of the Negative, and yielding a picture resembling, in its light and shade, an engraving; and of various hues, from a light bistre, through various gradations of violet and black. Positives can also be produced at once by employing the proper developing agent.

NASCENT STATE.—To act upon a substance in its nascent state, is to use it at the moment of its formation, and before the air, or other foreign body, has had time to modify it.

PRECIPITATION.—A substance held in solution in a liquid is *precipitated* by adding to the liquid another substance for which it has a greater affinity, through which it leaves the first substance and *precipitates* with the latter.

Rectification—Is the operation by which a substance is brought to a greater state of purity; in fluids this is sometimes accomplished by distillation; in certain solids by recrystallization.

Reduction—Is the operation by which the oxides of metals pass into a more or less perfectly metallic state.

Solution—Is the dissolving of a solid body in a liquid, such as water, alcohol, &c. Bodies are melted or fused by the action of heat, or by their chemical action upon each other; but these are not *solutions*, for which a *solvent* is required.

Saturation.—Saturated Solution.—Generally speaking, most liquids will only dissolve a certain given quantity of a solid body submitted to their action, varying, however, with the temperature at which the solution is made. Thus, 100 ounces of water at 60° will dissolve only 36 ounces of chloride of ammonium; if the water is at the boiling point, it will dissolve its own weight of the salt; but the excess is deposited again as the water cools down to 60°. It requires 143 ounces of iodide of potassium to saturate 100 ounces of water at 65°. Common salt is equally soluble in water at all temperatures.

Weights and Measures.

Apothecaries' Weight.

1 grain.
20 = 1 scruple.
60 = 3 = 1 drachm.

Fluid Measure.

								Grains.	
1 minim							=	0·91	
60 =	1 fluid drachm						=	54·7	*Avoird.*
480 =	8 =	1 fluid ounce					=	437·5	= 1 oz.
9,600 =	160 =	20 =	1 pint				=	8,750	= 1·25 ℔.
76,800 =	1280 =	160 =	8 =	1 gallon			=	70,000	= 10 ℔s.

One Pound Avoirdupois	contains	7,000	grains
One Pound Apothecaries', or Troy Weight		5,760	„
One Imperial Gallon of Water	„	70,000	„
One Imperial Pint of Water	„ 20 oz. or	8,750	„
One Cubic Inch of Water	„	252·4	„
One Ounce Avoirdupois	„	437·5	„
One Ounce Troy, or Apothecaries' Weight		480	„
One *Gramme*	„	15·4	„
One *Decigramme*	„	1·5	„
One *Litre* of Distilled Water is about $1\frac{3}{4}$ pints	„	15,406·3	„

*** The grain is the unit of weight; but as three standards of weight are employed, much uncertainty and confusion often arise in the mind of the photographer as to which ounce or drachm is meant. Apothecaries' weight is seldom used in larger quantities than the drachm; whenever ounces or pounds are prescribed the Avoirdupois pound of 7000 grains, divided into 16 ounces, is always employed.

APPENDIX.

PROCESSES ON PAPER.

1.—Iodizing the Paper.*

Take a sheet of the best writing-paper, having a smooth surface and a close and even texture; the watermark, if any, should be cut off, lest it should injure the appearance of the picture. Dissolve 100 grains of crystallized nitrate of silver in six ounces of distilled water. Wash the paper with this solution with a soft brush on one side, and put a mark on that side whereby to know it again. Dry the paper cautiously at a distance from the fire, or else let it dry spontaneously in a dark room. When dry, or nearly so, dip it into a solution of iodide of potassium, containing 500 grains of that salt dissolved in one pint of water, and let it stay two or three minutes in the solution. Then dip the paper into a vessel of water, dry it lightly with blotting-paper, and finish drying it at a fire, which will not injure it, even if held pretty near; or else it may be left to dry spontaneously. All this is best done in the evening by candle-light: the paper so far prepared is called *iodized paper*, because it has a uniform pale yellow coating of iodide of silver. It is scarcely sensitive to light, but nevertheless it ought to be kept in a portfolio, or drawer, until wanted for use. Mr. Talbot's process.

The calotype paper is rendered more sensitive by placing a warm iron behind it in the camera whilst the light is acting upon it.

Io-gallic paper is prepared by washing a sheet of iodized paper with gallic acid. In this state it will keep in a

* It has since been found a better method to iodize the paper previous to applying the nitrate of silver.

Iodizing the Paper.

portfolio, and is rendered sensitive to light by washing it over with a solution of nitrate of silver.

Iodized paper is washed with a mixture of twenty-six parts of a saturated solution of gallic acid to one part of the solution of nitrate of silver ordinarily used. It can then be dried without fear of spoiling, may be kept a little time, and used without further preparation.

Mr. H. Cundell's process.

Much depends upon the paper selected for the purpose; it must be of a compact and uniform texture, smooth and transparent, and of not less than medium thickness. The best I have met with is a fine satin post paper made by "R. Turner, Chafford Mill." Having selected a half-sheet, without flaw or watermark, and free from, even the minutest, black specks, the object is to spread over its surface a perfectly uniform coating of the iodide of silver, by the mutual decomposition of two salts, nitrate of silver and iodide of potassium. There is a considerable latitude in the degree of dilution in which these salts may be used, and also in the manner and order of their application; but as the thickness and regularity of the coating depend upon the solution of nitrate of silver, and upon the manner in which it is applied, I think it ought by all means to be applied first, before the surface of the paper is disturbed, I use a solution of the strength of seventeen grains to the ounce of distilled water.

The paper may be pinned by its two upper corners to a clean dry board a little larger than itself; and holding this nearly upright in the left hand, and commencing at the top, apply a wash of the nitrate of silver *thoroughly*, *evenly*, and *smoothly*, with a large soft brush, taking care that every part of the surface be thoroughly wetted, and that nothing remain unabsorbed in the nature of free or running solution.

Let the paper now hang loose from the board into the air to dry, and by using several boards time will be saved.

The nitrate of silver spread upon the paper is now to be saturated with iodine, by bringing it in contact with a

solution of the iodide of potassium ; the iodine goes to the silver, and the nitric acid to the potash. IODIZING THE PAPER.

Take a solution of the iodide of potassium of the strength of 400 grains to the pint of water, to which it is an improvement to add 100 grains of common salt. Pour the solution into a shallow, flat-bottomed dish, sufficiently large to admit the paper, and let the bottom of the vessel be covered to the depth of one-eighth of an inch. The prepared side of the paper, having been previously marked, is to be brought in contact with the surface of the solution ; and as it is desirable to keep the other side clean and dry, it will be found convenient, before putting it in the iodine, to fold upwards a narrow margin along the two opposite edges. Holding by the upturned margin, the paper is to be gently drawn along the surface of the liquid until its lower face be thoroughly wetted in every part ; it will become plastic, and in that state may be suffered to repose for a few moments in contact with the liquid : it ought not, however, to be exposed in the iodine dish for more than a minute altogether, as the new compound, just formed upon the paper, upon further exposure, would be gradually re-dissolved. The paper is, therefore, to be removed ; and after dripping, it may be placed upon any clean surface with the wet side uppermost, until about half dry, by which time the iodine solution will have thoroughly penetrated the paper, and have found out and saturated every particle of the silver ; which it is quite indispensable it should do, as the smallest particle of undecomposed nitrate of silver would become a black stain in a subsequent part of the process.

The paper is now covered with a coating of the iodide of silver ; but it is also covered, and indeed saturated, with saltpetre and the iodide of potassium, both of which it is indispensable should be completely removed. To effect the removal of these salts, it is by no means sufficient to dip the paper in water ; neither is it a good plan to wash the paper with any considerable motion, as the iodide of silver,

Iodizing the Paper.

having but little adhesion to it, is apt to be washed off. But the margin of the paper being still upturned, and the unprepared side of it kept dry, it will be found that by setting it afloat on a dish of clean water, and allowing it to remain for five or ten minutes, drawing it gently, now and then, along the surface to assist in removing the soluble salts; these will separate by their own gravity, and (the iodide of silver being insoluble in water) nothing will remain upon the paper but a beautifully perfect coating of the kind required.

The paper is now to be dried; but while wet do not, on any account, touch or disturb the prepared surface with blotting-paper or with anything else. Let it merely be suspended in the air, and in the absence of a better expedient, it may be pinned across a string by one of its corners: when dry, it may be smoothed by pressure. It is now "iodized" and ready for use, and in this state will keep any length of time if protected from the light.

Mr. Bingham's method.

Apply to the paper a solution of nitrate of silver containing 100 grains of that salt to one ounce distilled water. When nearly, but not quite dry, dip it into a solution of iodide of potassium of the strength of 25 grains of that salt to 1 ounce of distilled water, drain it, wash it, and then allow it to dry. Now brush it over with aceto-nitrate of silver, made by dissolving 50 grains nitrate of silver in 1 ounce distilled water, to which is added one-sixth its volume of acetic acid. Dry it with bibulous paper, and it is now ready for receiving the image.

Mr. Channing's method.

The paper should be first washed over with 60 grains of nitrate of silver dissolved in 1 ounce distilled water, and when dry, with a solution of 10 grains of iodide of potassium in 1 ounce water; it is then to be washed in water and dried between folds of blotting-paper: the sensibility of the paper is said, and correctly, to be much improved by combining a little chloride of sodium with

the iodide of potassium, 5 grains of the latter salt, and rather less than that of the former, in an ounce of water, may be employed advantageously. Iodizing the Paper.

To use this paper where time is an object, it is necessary to wash it immediately before it is placed in the camera with a weak solution of nitrate of silver, to which a drop or two only of gallic acid have been added. The picture is subsequently developed by the gallo-nitrate of silver.

Iodide of silver is precipitated from the solution of the nitrate by iodide of potassium; and this precipitate, being lightly washed, is redissolved in a strong solution of the latter salt. The solution is applied to the paper, and the paper allowed to dry: after this it is placed, face downwards, upon some clean water; the iodide of potassium is removed by this, and a pure iodide of silver left upon the paper. Mr. Jordan's method.

M. Martens uses spirits of wine after the picture has been developed, to improve its tone. M. Martens' method.

For the negative picture:

First,—

Iodide of potassium	½ oz.
Distilled water	10 „
Concentrated solution of cyanide of potassium	7 drops.

Second,—

Nitrate of silver	7 drachms
Distilled water	10 oz.
Strong acetic acid . . .	2 drachms.

The iodine solution should be applied first, and dried; then the argentine solution and dried rapidly: the advantages of this are, that the iodide of silver is left on the

Iodizing the Paper.

surface of the paper ready for the influence of the slightest chemical action.

Third,—

A concentrated solution of gallic acid.

Fourth,—

Good spirits of wine.

Fifth,—

Hyposulphite of soda	1 oz.
Distilled water	10 „

For the positive pictures:

First,—

Chloride of sodium	168 grains
Distilled water	10 oz.

Second,—

Nitrate of silver	1 oz.
Distilled water	10 „

Third,—

Hyposulphite of soda	1 oz.
Distilled water	10 „

Nitrate of silver 30 grains, dissolved in ½ oz. of water, to be poured into the solution in a small stream, while it is constantly stirred with a glass rod.

M. Le Gray's process.

For negatives:

First operation,—

Isinglass, 1 ounce, dissolved in 2 pints of distilled water by means of a water-bath.

Take one-half of this preparation while warm, and add to it as under,—

Iodide of potassium	200 grains
Bromide of potassium	60 „
Chloride of sodium	34 „

Let these salts be well dissolved, then filter the solution through a piece of paper; put it, still warm, in a large dish, and plunge in your paper completely, leaf by leaf, one on the other, taking care to prevent the air-bubbles from adhering to the paper. IODIZING THE PAPER.

Put about twenty leaves at a time into the dish, then turn the whole, those at the top to the bottom; then take them out one by one, and hang them by one corner with a pin bent like the letter S, to dry spontaneously. When hung up, attach to the opposite corner a piece of bibulous paper, which will facilitate the drying.

When the paper is dry, cut it to the size required, and preserve it in a folio for use. This paper may be made in the day-time as it is not sensitive to light.

Second operation,—

Prepare, by the light of a taper, the following solution in a stoppered bottle:

Nitrate of silver	250 grains
Distilled water	6 fl. ounces

When the nitrate is dissolved, add,

Crystallizable acetic acid . .	1 ounce

Cover the bottle with black paper, and keep it from the light.

When you wish to operate, pour the solution upon a porcelain or glass slab, having a border of glass or wax; take a sheet of the iodized paper by the two corners, holding them perpendicularly, and gently lower the middle of the paper upon the centre of the slab, gradually depress until the sheet is equally spread: repeat this operation several times until the air-bubbles disappear, taking also the precaution to keep the upper side of the paper dry. Let the sheet remain upon the slab until the formation of the chloro-bromo-iodide of silver is perfect. This may be

Iodizing the Paper.

known by the disappearance of the violet colour, which the back of the paper at first presented: it must not be left longer, otherwise it would lose its sensitiveness. The time required to effect this chemical change is from one to five minutes, depending upon the quality of the paper.

Spread upon a glass, fitted to the frame of the camera, a piece of white paper well soaked in water; upon this place the prepared sheet, the sensitive side upwards.

Mr. Thomas's method.

Select old and thin English paper—I prefer Whatman's—and cut it to the size of the frames. Prepare the following solution,—

Saturated solution of iodide of potassium	2½ fl. drachms
Pure iodine	9 grains.

Dissolve, then add,—

Distilled water	11½ oz.
Iodide of potassium	4 drachms
Bromide of potassium	10 grains,

and mix. Filter the mixture into a shallow porcelain vessel, and place a sheet of paper carefully on the surface of the fluid, and let it remain about two minutes; if French paper, one minute, or until the iodine tint shows through the paper, which must not be wetted at the back. Hang it up by one corner to drain and dry.

To excite this paper, lay it upon a solution of

Nitrate of silver	2½ drachms
Acetic acid	4½ „
Distilled water	3½ oz.

This paper is used in the camera by the *wet* method, p. 48.

The object was taken by an achromatic lens of three inches diameter, and half-inch diaphragm; and, if well lighted by the sun, in from four to six minutes' exposure.

The image takes from ten to twenty minutes to develope in a solution of gallic acid. It may be fixed in the usual manner by the hyposulphite of soda, or by a solution of bromide of potassium, ten grains to the ounce of water. Exciting the Paper.

2.—Exciting the Paper for the Camera.

For this purpose are required two solutions, as described by Mr. Talbot,—viz. a saturated solution of crystallized gallic acid in cold distilled water, and a solution of nitrate of silver, of the strength of fifty grains to the ounce of distilled water; to which is added one-sixth part of its volume of glacial acetic acid. For many purposes these solutions are unnecessarily strong, and, unless skilfully handled, they are apt to stain or embrown the paper; where extreme sensitiveness, therefore, is not required, they may with advantage be diluted to half the strength, in which state they are more manageable, and nearly as effective. The gallic-acid solution will not keep for more than a few days, and only a small quantity, therefore, should be prepared at a time. When these solutions are about to be applied to the iodized paper, they are to be mixed together in equal volumes, by means of a graduated drachm tube. The mixture is called the "gallo-nitrate of silver." As it speedily changes, and will not keep more than a few minutes, it must be used without delay; and it ought not to be prepared until the operator is quite ready to apply it. Mr. H. Cundell's process.

The application of this "gallo-nitrate" to the paper is a matter of some nicety. It will be found best to apply it in the following manner:—Pour out the solution upon a clean slab of plate-glass, diffusing it over the surface to a size corresponding to that of the paper: holding the paper by a narrow, upturned margin, the sensitive side is to be applied to the liquid upon the slab, and brought in

Exciting the Paper.

contact with it by passing the fingers gently over the back of the paper, which must not be touched with the solution.

As soon as the paper is *wetted* with the gallo-nitrate, it ought instantly to be removed into a dish of water: five or ten seconds at the most is as long as it is safe, at this stage, to leave the paper to be acted upon by the gallo-nitrate; in that space of time it absorbs sufficient to render it exquisitely sensitive. The excess of gallo-nitrate must immediately be washed off, by drawing the paper gently several times under the surface of water, which must be perfectly clean; and, being thus washed, it is finished by drawing it again through fresh water two or three times. It is now to be dried in the dark, and, when the surface is dry, it may either be placed, while still damp, in the camera, or in a portfolio among blotting-paper for use. If properly prepared, it will keep perfectly well for four-and-twenty hours at least, retaining all its whiteness and sensibility.

3.—Exposure in the Camera.

Mr. H. Cundell's process.

The exposure in the camera, for which, as the operator must be guided by his own judgment, few directions can be given, and few are required. He must choose or design his own subject: he must determine upon the aperture to be used, and judge of the time required, which will vary from a few seconds to three or four minutes. The subject ought, if possible, to have a strong and decided effect; but extreme lights, or light-coloured bodies, in masses, are by all means to be avoided. When the paper is taken from the camera, very little or no trace whatever of a picture is visible, until it is subjected to the fourth process, which is—the Bringing out of the Picture.

Bringing out the Picture.

4.—Developing the Picture.

Mr. H. Cundell's method

The development of the picture is effected by again applying the "gallo-nitrate" as before directed. As soon as the paper is wetted all over, unless the picture appears immediately, it is to be exposed to the *radiant* heat from a smoothing iron, or any similar body, held within an inch or two by an assistant. It ought to be held vertically, as well as the paper; and the latter ought to be moved so as to prevent any one part of it becoming dry before the rest.

As soon as the picture is sufficiently brought out, wash it immediately in clean water to remove the gallo-nitrate, as before directed; it may then be placed in a dish by itself, under water, until you are ready to fix it. The most perfect pictures are those which come out before any part of the paper becomes dry, which they will do if sufficiently impressed in the camera. If the paper be allowed to dry before washing off the gallo-nitrate, the lights sink and become opaque; and if exposed in the dry state to heat, the paper will embrown; the drying, therefore, ought to be *retarded*, by wetting the back of the paper, or the picture may be brought out by the vapour from hot water, or, what is better, from a horizontal jet of steam.

5.—Fixing the Picture.

Mr. H. Cundell's method

The fixing of the picture is accomplished by removing the sensitive matter from the paper. The picture, or as many of them as there may be, is to be soaked in warm water, but not warmer than may be borne by the finger; this water is to be changed once or twice, and the pictures are then to be well drained, and either dried all together, or pressed in clean dry blotting-paper, to prepare them to imbibe a solution of the hyposulphite of soda, which may be made by dissolving an ounce of that salt in a quart of

Fixing the Picture.

water. Having poured a little of the solution into a flat dish, the pictures are to be introduced into it one by one; daylight will not now injure them: let them soak for two or three minutes, or even longer, if strongly printed, turning and moving them occasionally. The remaining unreduced salts of silver are thus thoroughly dissolved, and may now, with the hyposulphite, be entirely removed by soaking in water, and *pressing* in clean white blotting-paper, alternately; but if time can be allowed, soaking in water alone will have the effect in twelve or twenty-four hours, according to the thickness of the paper.

It is essential to the success of the fixing process that the paper be, in the first place, thoroughly penetrated by the hyposulphite, and the sensitive matter dissolved: and next that the hyposulphite compounds be effectually removed. Unless these salts are completely removed, they induce a destructive change upon the picture, they become opaque in the tissue of the paper, and entirely unfit it for the next, or printing process.

6.—The Printing Process.

Mr. H. Cundell's method.

The picture being thus fixed, it has merely to be dried and smoothed, when it will undergo no further change. It is, however, a *negative* picture, and if it have cost some trouble to produce it, that trouble ought not to be grudged, considering that you are now possessed of a matrix which is capable of yielding a vast number of beautiful impressions.

The manner of obtaining these impressions has been so often described, and there are so many different modes of proceeding, that it may be sufficient to notice very briefly the best process with which I am acquainted. Photography is indebted for it to Dr. Alfred S. Taylor. This solution is made by dissolving one part of nitrate of silver in twelve of distilled water, and gradually adding strong liquid ammonia

until the precipitate at first produced is at length *just* re-dissolved. Various Methods.

Some paper is to be met with containing traces of bleaching chlorides, which does not require any previous preparation ; but in general it will be found necessary to prepare the paper by slightly impregnating it with a minute quantity of common salt. This may be done by dipping it in a solution in which the salt can scarcely be tasted, or of the strength of from thirty to forty grains to a pint of water. The paper, after being pressed in clean blotting-paper, has merely to be dried and smoothed, when it will be fit for use.

The ammonio-nitrate of silver is applied to the paper in the manner described in Section 3 ; and when perfectly dry the negative picture to be copied is to be applied to it, with its face in contact with the sensitive side. The back of the negative picture being uppermost, they are to be pressed into close contact by means of a plate of glass ; and thus secured, they are to be exposed to the light of the sun and sky. The exposed parts of the sensitive paper will speedily change to lilac, slate-blue, deepening towards black ; and the light gradually penetrating through the semi-transparent *negative* picture, will imprint upon the sensitive paper beneath a *positive* impression. The negative picture, or matrix, being slightly tacked to the sensitive paper by two mere particles of wafer, the progress of the operation may from time to time be observed, and stopped at the moment when the picture is finished.

It ought, then, as soon as possible, to be soaked in warm water, and fixed in the manner described in Section 14.

Prepare the paper by floating it in a solution of fifteen grains of nitrate of lead in an ounce of water. It is then placed on a solution of ten grains of iodide of iron to an ounce of water ; left two minutes and blotted off. The paper, while moist, is rendered sensitive by a solution of nitrate of silver, 100 grains to an ounce of water, and placed Mr. Miller's process.

VARIOUS METHODS.

in a camera. After exposures the image gradually developes itself without any further application, and is fixed by hyposulphite of soda. This is a most striking discovery, as it supersedes the necessity of any developing agent after the light has acted on the paper.

Mr. Stewart's process.

The following observations are confined to negative paper processes, divisible into two—the *wet* and the *dry*. The solutions I employ for both these processes are identical, and are as follows :—

Solution of iodide of potassium, of the strength of 5 parts of iodide to 100 of pure water.

Solution of aceto-nitrate of silver, in the following proportions : 15 parts of nitrate of silver ; 20 of glacial acetic acid ; 150 of distilled water.

Solution of gallic acid, for developing ; a saturated solution.

Solution of hyposulphite of soda ; of the strength of one part hypo. of soda to from 6 to 8 parts water.

The solutions employed are thus reduced to their simplest possible expression, for it will be observed that in iodizing I employ neither rice-water, sugar of milk, fluoride, cyanuret, nor free iodide, &c. &c. ; but a simple solution of iodide of potassium. [The *strength* of this solution is a question of considerable importance, not yet, I think, sufficiently investigated.]

For both the wet and the dry processes I iodize my paper as follows :—In a tray containing the above solution I plunge, one by one, as many sheets of paper (twenty, thirty, fifty, &c.) as are likely to be required for some time. This is done in two or three minutes. I then roll up loosely the whole bundle of sheets, while in the bath ; and picking up the roll by the ends, drop it into a cylindrical glass vessel with a foot to it, and pour the solution therein, enough to cover the roll completely (in case it should float up above the surface of the solution, a little piece of glass

may be pushed down to rest across the roll of paper and prevent its rising). The vessel with the roll of paper is placed under the receiver of an air-pump, and the air exhausted; this is accomplished in a very few minutes, and the paper may then be left five or six minutes in the vacuum. Should the glass be too high (the paper being in large sheets) to be inserted under a pneumatic pump-receiver, a stiff lid lined with India-rubber, with a valve in the centre communicating by a tube with a common direct-action air-pump, may be employed with equal success. After the paper is thus soaked *in vacuo* it is removed, and the roll is dropped back into the tray with the solution, and then, sheet by sheet, picked off and hung up to dry, when, as with all other iodized paper, it will keep for an indefinite time.

VARIOUS METHODS.

Mr. Stewart's process.

I cannot say that I fully understand the rationale of the action of the air-pump, but several valuable advantages are obtained by its use :—1st. The paper is thoroughly iodized and with an *equality* throughout that no amount of soaking procures, for no two sheets of paper are alike, or even one perfect throughout in texture; and air-bubbles are impossible. 2d. The operation is accomplished in a quarter of an hour, which generally employs one, two, or more hours. 3d. To this do I chiefly attribute the fact that my paper is never solarized even in the brightest sun; and that it will bear whatever amount of exposure is necessary for the deepest and most impenetrable shadows in the view, without injury to the bright lights.

Wet Process.—To begin with the *wet* process. Having prepared the above solution of aceto-nitrate of silver, float a sheet of the iodized paper upon the surface of this sensitive bath leaving it there for about ten minutes. During this interval, having placed the glass or slate of your slider quite level, dip a sheet of *thick* clean white printing (unsized) paper in water, and lay it on the glass or slate as a wet lining to receive the sensitive sheet. An expert manipulator

Wet process

Various Methods.

Mr. Stewart's process.

may then, removing the sensitive sheet from the bath, extend it (sensitive side uppermost) on this wet-paper lining, without allowing any air-globules to intervene. But it is difficult, and a very simple and most effectual mode of avoiding air-globules, particularly in handling very large sheets, is as follows :—Pour a layer of water (just sufficient not to flow over the sides) upon the lining paper, after you have extended it on your glass or slate, and then lay down your sensitive paper gently and by degrees, and floating as it were on this layer of water ; and when extended taking the glass and papers between the finger and thumb, by an upper corner, to prevent their slipping, tilt it gently to allow the interposed water to flow off by the bottom, which will leave the two sheets of paper adhering perfectly and closely, without the slightest chance of air-bubbles :—it may then be left for a minute or two, standing upright in the same position to allow every drop of water to escape ; so that when laid flat again or placed in the slider none may return back and stain the paper. Of course the sensitive side of the sheet is thus left exposed to the uninterrupted action of the lens, no protecting plate of glass being interposed,—and even in this dry and warm climate I find the humidity and the attendant sensitiveness fully preserved for a couple of hours.

To develope views thus taken, the ordinary saturated solution of gallic acid is employed, never requiring the addition of nitrate of silver ; thus preserving the perfect purity and varied modulation of the tints. The fixing is accomplished as usual with hyposulphite of soda, and the negative finally waxed.

Dry process.

Dry Process.—In preparing sheets for use when *dry* for travelling, &c., I have discarded the use of *previously waxed* paper, thus getting rid of a troublesome operation,—and proceed as follows :—Taking a sheet of my iodized paper, in place of floating it (as for the wet process) on the sensitive bath, I plunge it fairly into the bath, where it is left

to soak for five or six minutes ; then removing it, wash it for about twenty minutes in a bath, or even two, of distilled water to remove the excess of nitrate of silver, and then hang it up to dry (in lieu of drying it with blotting-paper). Paper thus prepared possesses a greater degree of sensitiveness than waxed paper, and preserves its sensitiveness, not so long as waxed paper, but sufficiently long for all practical purposes,—say thirty hours, and even more. The English manufactured paper is far superior for this purpose to the French. To develope these views, a few drops of the solution of nitrate of silver are required in the gallic acid bath. They are then finally fixed and waxed as usual.

Various Methods.

Mr. Stewart's process.

These processes appear to me to be reduced to nearly as great a degree of simplicity as possible. I am never troubled with stains or spots, and there is a regularity and certainty in the results that are very satisfactory. You will have observed, too, how perfectly the aerial perspective and gradation of tints are preserved—as also how well the deepest shadows are penetrated and developed—speaking, in fact, as they do to the eye itself in nature. In exposing for landscape, I throw aside all consideration of the bright lights, and limit the time with reference entirely to the dark and feebly-lighted parts of the view ; with a $3\frac{1}{4}$-inch lens : the time of exposure has thus varied from ten minutes to an hour and a half, and the action appears to me never to have ceased.

The influence of the air-pump in this appears to me very sensible, and deserving of further examination and extension. I purpose not only iodizing, but rendering the paper sensitive with the action of the air-pump, by perhaps suspending the sheet after immersion in the nitrate bath under the receiver of the air-pump for a few minntes, before exposure in the camera, or by some other manœuvre having the same object in view.

I should add, that I have chiefly employed Canson's French paper in iodizing with the aid of the pump. Few

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of the English manufactured papers are sufficiently tenacious in their sizing to resist the action of the pump, but they may easily be made so; and were, in short, the English paper, so far superior in quality to the French, only better-sized, that is, with glue less easily soluble, even though more *impure*, there is scarcely any limit to the beauty of the views that might be produced.

There are more minor details that might be given; but I fear repeating many a "twice-told tale," acquainted so little as I am with what is doing;—the preceding, however, may have some interest, and whatever is of value is entirely due to our friend M. Regnault, ever so generously ready as well as able to aid and encourage one's efforts.

On the Simplicity of the Calotype Process.

By Dr. Diamond.

Extracts from a Paper read before the Photographic Society, November 3d, 1853.

Dr. Diamond's process.

I think more failures than any others depend upon not having good iodized paper, which may result—

1. From the quality of the paper;
2. The mode of preparing it;
3. The want of proper *definite* proportions for a particular make of paper;

because I find very different results ensue unless these things are relatively considered.

I have not met with satisfactory results in iodizing the French and German papers, and the thick papers of some of our English makers are quite useless.

Turner's paper, of the "Chafford Mills" make, is greatly to be preferred, and therefore I will presume that to be used, and of a medium thickness. The great fault of Turner's paper consists in the frequent occurrence of

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spots, depending upon minute portions of brass coming from the machinery, or from the rims of buttons left in the rags when being reduced to pulp; and thus a single button chopped up will contaminate a large portion of paper. Occasionally these particles are so large that they reduce the silver solutions to the metallic state, which is formed on the paper; at other times they are so minute as to simply decompose the solution, and white spots are left, much injuring the effect of the picture.

Whatman's paper is much more free from blemishes, but it is not so fine and compact in its texture, the skies in particular exhibiting a minutely speckled appearance, and the whole picture admitting of much less definition.*

It may not be inappropriate to mention here, in reference to the minuteness attainable by paper negatives, that a railway notice of six lines is perfectly legible, and even the erasure for a new secretary's name is discernible in the accompanying specimen, which was obtained with one of Ross's landscape lenses, without any stop whatever being used, and after an exposure of five minutes *during a heavy rain*. The sky is scarcely so dense as could be desired, which will be fully accounted for by the dull state of the atmosphere during the exposure in the camera.

Having selected your paper as free from blemishes as possible, which is most readily ascertained by holding it up to the light (the rejected sheets doing perfectly well for positives, it is well to reject *all* those upon which *any* doubt exists), mark the smoothest surface;—the touch will always indicate this, but it is well at all times not to handle the surfaces of papers more than can be avoided. There is much difference in various individuals in this respect; some will leave a mark upon the slightest touch, whereas others may rub the paper about with perfect impunity.

* The effect was well illustrated in two negatives of the same subject, taken at the same time, exhibited to the meeting.

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I prefer the paper to be iodized by the single process, because, independently of the ease and economy of time, I think more rapidity of action is attained by paper so treated, as well as a greater intensity of the blacks, so requisite for producing a clear picture in after printing.

Take sixty grains of nitrate of silver and sixty grains of iodide of potassium, dissolve each separately in an ounce of distilled water, mix and stir briskly with a glass rod so as to ensure their *perfect* mixture: the precipitated iodide of silver will fall to the bottom of the vessel; pour off the fluid, wash once with a little distilled water, then pour upon it four ounces of distilled water and add 650 grains of iodide of potassium, which *should* perfectly redissolve the silver and form a clear fluid; should it not (for chemicals differ occasionally in their purity), then a little more should be very cautiously added until the effect is produced.

The marked side of the paper being laid upon the surface of this fluid in a proper porcelain or glass dish, immediately remove it, lay it upon its dry side upon a piece of blotting-paper and stroke it over once or twice with a glass rod; this as effectually expels all the particles of air as complete immersion, it is also more economical, and has the advantage of requiring much less time in the after-immersion in the "hypo" when it is required to remove the iodide. Either pin the paper up or lay it down upon its dry side, and when it becomes tolerably dry (perfect dryness is not requisite) immerse it in common cold water for the space of four hours, changing the water during that time three or four times, so that all the soluble salts may be removed; often move the papers, so that when several sheets are together, one does not press so much upon another that the water does not equally arrive at all the surface.

If this paper is well made it is of a pale straw colour, or rather primrose, and perfectly free from unevenness of tint. It will keep good for several years; if, however, the

soluble salts have not been *entirely* removed, it attracts damp, and becomes brown and useless or uncertain in its application.

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Upon the goodness of your iodized paper of course depend the future results. Although it is not requisite to prepare it by candle-light, which is, in fact, objectionable from your inability to see if the yellow tint is equally produced, I think it should not be exposed to too strong a light; and as the fly-fisher in the dull winter months prepares his flies ready for the approaching spring, so may the photographer in the dull weather which now prevails, with much advantage prepare his stock of iodized paper ready for the approach of fine weather. Many other ways have been recommended which have proved successful in different hands. Dr. Mansell of Guernsey pours the iodide solution upon his paper, which previously has had all its edges turned up so as to resemble a dish; he rapidly pours it off again after it has completely covered the paper, and then washes it in three waters for only ten minutes in all: he considers that thereby none of the size of the paper is removed, and a more favourable action is obtained. In the experiments I have tried with the use of the air-pump, as recommended by Mr. Stewart, I have met with much trouble and little success, and I am inclined to attribute the very beautiful specimens which he has produced, to his own good manipulation under a favourable climate.

To excite the paper, take

10 drops (minims) of solution of aceto-nitrate of silver and 10 drops of saturated solution of gallic acid, mixed with 3 drachms of distilled water.

The aceto-nitrate solution consists of—

Nitrate of silver . . .	30 grains.
Glacial acetic acid . . .	1 drachm.
Distilled water . . .	1 ounce.

If the weather is warm, 6 drops of gallic acid will suffice, and enable the prepared excited paper to be kept longer.

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This may be applied, either directly by means of the glass rod, or by floating, as before, and then the glass rod. If floating is resorted to, then a larger quantity must be prepared. The paper should be blotted off by means of blotting-paper (which should never be used more than once, although preserved for other purposes), and put into the dark frames for use. It is not requisite that the paper should be perfectly dry. This exciting should be conducted by a very feeble light: the paper is much more sensitive than is generally supposed; in fact, it is then in a state to print from, by the aid of gas or the light of a common lamp, and very agreeable positives are so produced by this negative mode of printing.

I would advise the aceto-nitrate of silver and the solution of gallic acid to be kept in two bottles with wooden cases differing in their shape, so as not to mistake when operating in comparative darkness. A $\frac{1}{4}$ of an ounce of gallic acid put into such a 3-ounce bottle, and *quite* filled up with distilled water as often as any is used, will serve a very long time.

I would advise that the paper should be excited upon the morning of the day upon which it is intended to be used; no doubt the longer it is kept the less active and certain it becomes. I have, however, used it successfully eight days after excitement, and have a good negative produced at that length of time. The general medium time of exposure required is five minutes. In the negatives exhibited, the time has varied from three minutes to eight, the latter being when the day was very dull.

The pictures should be developed by equal quantities of the aceto-nitrate of silver and the saturated solution of gallic acid, which are mixed and immediately applied to the exposed surface. This may be done several hours after the pictures have been removed from the camera. Care should be taken that the back of the picture does not become wetted, as this is apt to produce a stain which may print off upon the positive.

If upon the removal of the paper from the slide the picture is very apparent, by first applying a little gallic acid, and immediately afterwards the *mixed* solutions, less likelihood is incurred of staining the negative, from its being more evenly and intensely developed.

If a browning takes place, a few drops of strong acetic acid will generally check it. Should the picture be very tardy, either from an insufficient exposure, want of light, or other cause, a few drops of a solution of pyro-gallic acid, of 3 grains to the ounce of water, and a drachm of acetic acid, will act very beneficially. It sometimes gives an unpleasant redness upon the surface, but produces great intensity upon looking through it.

Until the pyrogallic solution was added, there was scarcely anything visible upon this paper, the failure having in the *first* instance happened from the badness of the iodized paper.

As soon as the picture is sufficiently developed it should be placed in water, which should be changed once or twice; after soaking for a short time, say half-an-hour, it may be pinned up and dried, or it may at once be placed in a solution almost saturated, or quite so, of hyposulphite of soda, remaining there no longer than is needful for the entire removal of the iodide, known by the disappearance of the yellow colour.

When travelling, it is often desirable to avoid using the hyposulphite, for many reasons (besides that of getting rid of extra chemicals), and it may be relied on that negatives will keep even under exposure to light for a very long time. I have kept some myself for several weeks, and I believe Mr. Rosling has for some months.

The hyposulphite, lastly, should be effectually removed from the negative by soaking in changed waters.

Some prefer to use the "hypo" quite hot, or even boiling, as thereby the size of the paper is removed, allowing of its being readily afterwards waxed. I have always found that pouring a little boiling water upon the

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paper effectually accomplishes the object; some negatives will readily wax even when the size is not removed. A very hot box iron is best for the purpose: but the most important thing to attend to is that the paper should be perfectly dry, and it should therefore be passed between blotting-paper and well ironed before the wax is applied. Negatives will even attract moisture from the atmosphere, and therefore this process should be resorted to immediately before the application of the wax.

Before concluding these remarks, I would draw the attention of the Meeting to the great convenience of the use of a yellow bag, made so large as to entirely cover the head and shoulders, confined round the waist by means of a stout elastic band. It was first, I believe, used by Dr. Mansell. In a recent excursion, I have with the greatest ease been enabled to change all my papers without any detriment whatever, and thereby dispensed with the weight of more than a single paper-holder. The bag is no inconvenience, and answers perfectly well to obstruct the light of a window, if not protected with shutters.

I would also beg to mention that a certain portion of the bromide of silver introduced into the iodized paper seems much to accelerate its power of receiving the green colour, as it undoubtedly does in the collodion. Although it does not accelerate its *general* action, it is decidedly a great advantage for foliage. Its best proportions I have not yet been able to determine.

I would also offer a caution upon too great reliance being placed upon the use of gutta-percha vessels when travelling, as during the past summer I had a bottle containing distilled water, which came into pieces, and I have now a new gutta-percha tray which has separated from its sides. This may appear trivial, but when away from home the greatest inconvenience results from these things, which may be easily avoided.

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